PROCEEDINGS

OF THE

Ohio Gas Light Association.

SEVENTEENTH ANNUAL MEETING,

DAYTON,

MARCH 20 and 21, 1901.

EIGHTEENTH ANNUAL MEETING,

COLUMBUS,

MARCH 19 and 20, 1902.

NINETEENTH ANNUAL MEETING,

CINCINNATI,

MARCH 18, 19 and 20, 1903.

Published by the Association.
Edited by the Secretary.
1904.

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Seventeenth Annual Meeting

HELD AT

THE NATIONAL CASH REGISTER HALL,
DAYTON, OHIO.

March 20th and 21st, 1901.

PUBLISHED BY THE ASSOCIATION.
EDITED BY THE SECRETARY.

SEVENTEENTH ANNUAL MEETING

OF THE

Ohio Gas Light Association,

HELD

MARCH 20th and 21st, 1901.

PROCEEDINGS.

FIRST DAY—MORNING SESSION.

At 10 o'clock A. M. the Association was called to order by the President, Mr. George Whysall.

Upon roll call the following members reported their attendance:

E. D. Abbott,
C. W. Andrews,
Chester L. Arthur,
Geo. W. Barnes,
J. W. Beckwith,
William E. Bender,
W. C. Boyle,
H. S. Brooks,
Irvin Butterworth,
B. E. Chollar,
G. N. Clapp,
Moses Coombs,
F. G. Corbus,
Alfred D. Cressler,
Chas. W. DeArmon,
John Dell,
R. R. Dickey,
Ernest E. Eysenbach,
John Franklin,
F. L. Garrison,
John M. Gregory,
W. S. Gribbel,
J. W. Gwynn,
L. C. Hamlink,
E. W. Hanley,
John P. Harbison,
H. D. Harper,
J. A. Harris,
Sterling F. Hayward,
J. S. Hedges,
E. H. Henderson,
A. G. Holmes,
E. C. Humphreys,
E. D. Johnson,
T. C. Jones,
Lazard Kahn,
Wm. H. Knight,
Nathan G. Leakey,
E. H. Light,
George Light,

Joseph Light,
Ernest F. Lloyd,
James T. Lynn,
John R. Lynn,
John D. McIlhenny,
John McMillan,
Neil B. Mallon,
Edward M. Mancourt,
F. B. Many,
C. T. Mason,
J. H. Maxon,
J. D. S. Neely,
H. L. Olds,
G. W. Parker,
C. B. Pattrell,
Frank K. Pelton,
B. W. Perkins,
Fred. R. Persons,
W. W. Price,
Charles H. Printz,
Eugene Printz,
Charles S. Ritter,
George D. Roper,
D. R. Russell,
D. E. Sapp,
C. A. Schwarm,
Joseph Simpson,
George M. Smart,
D. C. Spinning,
A. J. Stacey,
F. A. Stacey,
J. E. Stacey,
Chas. L. Steenbergen,
J. G. Stephens,
Robert Bruce Steward,
F. W. Stone,
J. F. Stukenborg,
H. J. Trenkamp,
John Walters,
L. W. Wells,
B. F. Wendler,
George Whysall,
Leigh Wickham,
George W. York.

President Whysall:—Gentlemen of the Ohio Gas Light Association, the first order of business at our Seventeenth Annual Meeting is an address of welcome by Hon. J. R. Lindermuth, Mayor of Dayton. The Secretary informs me that Mr. Lindermuth has been called out of the city, and has deputized Mr. George M. Smart, Secretary of the Dayton Gas Light and Coke Company, to welcome us. I now have the pleasure of presenting him to you.

Mr. Smart then delivered the following

ADDRESS OF WELCOME.

Mr. President and Members of the Ohio Gas Light Association:

The welcoming address was to have been given by His Honor, the Mayor, Mr. J. R. Lindermuth, but he has gone out of the city and will be unable to be present to-day. He left me a short letter addressed to Mr. Whysall, which I will read.

Mr. Whysall, President, the Ohio Gas Light Association:

Sir:—Your kind invitation to be present at the seventeenth annual meeting of the Ohio Gas Light Association in our city

received. I will be out of the city at that time. I assure you that it gives me great pleasure to welcome the Association, and regret that I will not be present to personally extend the hospitality of the Gem City.

I feel confident that the genial gentlemen of the local Committee on Entertainment will see that you are accorded the freedom of the city. They are familiar with the objects of interest and its "lights and shadows," and will undoubtedly mingle pleasure with the business of your Association. May you, one and all, have a pleasant time during your stay with us.

Yours very truly,

Dayton, O., March 18, 1901. J. R. LINDERMUTH.

In addition to what he said in this letter, I may say as a member of the local committee, that we, one and all, desire to welcome you to this city, and will do everything in our power to make your stay pleasant and agreeable, so that at some future time you may see fit to meet with us again. Anything that any of the gentlemen present may desire will be cordially accorded to them, if it is possible so to do.

PRESIDENT WHYSALL:—I will call on Mr. D. E. Sapp, of Mt. Vernon, O., to respond. On behalf of the Ohio Gas Association, I now have the pleasure of presenting to you Mr. Sapp, who will respond to the cordial welcome extended to us by Mr. Smart.

Mr. Sapp, of Mt. Vernon, O., then delivered the following

RESPONSE.

MR. PRESIDENT:—It is a matter of some embarrassment to me to learn that the mayor is not here, to whom I could express, on behalf of the Association, our thanks for this very cordial welcome. It has been a pleasure, I am sure, for the convention to have assembled here. Some of us know Dayton from personal experience; others of us know it by reputation—a reputation which its industries and its institutions have spread abroad. It has been accorded to me to say to the mayor, and through him to the citizens of Dayton, that many of us perhaps, during the intervals of our sessions, would employ this opportunity to visit these industries and enterprises and carry away from the Gem City the helpful suggestions they will afford us. I repeat, Mr. President, that with, perhaps, a carefully prepared address in re-

sponse to the welcoming of the mayor, I am, as you will appreciate, confronted with some embarrassment, which arises from the fact that the mayor is not here. Need I say more, Mr. President, to our genial friend, Mr. Smart, and through him to the citizens of Dayton, than to accept with thanks the cordial welcome which has been extended to us, and to say on behalf of the Association that we shall carry away from Dayton many very pleasant and agreeable recollections?

PRESIDENT WHYSALL:—According to the printed program, the next order of business is the reading of the minutes of the last meeting. I might say that the chair will entertain a motion to dispense with the reading of the minutes, as they are quite extensive.

On motion of Mr. Andrews, seconded and carried, the reading of the minutes of the last meeting was then dispensed with.

PRESIDENT WHYSALL:—The next order of business is the report of the Executive Committee.

The report of the Executive Committee was then read by Secretary T. C. Jones, of Delaware, Ohio, as follows:

REPORT OF THE EXECUTIVE COMMITTEE.

To the Members, the Ohio Gas Light Association:

GENTLEMEN:—Your Executive Committee begs leave to submit, for your consideration, the following recommendations and report:

First.—That Irvin Butterworth, L. W. Wells and Charles H. Printz be appointed a Nominating Committee.

Second.—That B. E. Chollar, John R. Lynn and J. A. Stacey be appointed a Committee on Memorial.

Third.—That F. R. Persons, B. W. Perkins and E. B. Abbott be appointed a Committee on Next Place of Meeting.

Fourth.—That D. E. Dangler, Jerome Penn, Frederick Waugh, W. W. Canteen, Thomas H. Birch, George W. McCook and O. P. Taylor be released from membership at their own request.

Fifth.—That J. A. Fox, Charles H. Jacobs and A. F. Nash be dropped from membership for non-payment of dues.

Sixth.—That the following be elected to active membership:

New Members.

Arthur, Chester L., Vice-President The Upstill-Arthur Coal Co., Cincinnati, O.

Bender, W. E., Secretary The Hamilton-Otto Coke Co., Hamilton, O.

Brooks, W. S., Salesman William Resor & Co., Cincinnati, O.

Beckwith, J. W., Superintendent Oberlin Gas and Electric Co., Oberlin, O.

Forstall, Alfred E., Consulting Engineer, New York City.

Hamlink, L. C., Agent Laclede Fire Brick Manufacturing Co., St. Louis, Mo.

Humphreys, E. C., Sales Agent United States Cast Iron Pipe and Foundry Co., Cincinnati, O.

Holmes, A. G., Secretary and Manager Pittsburgh Meter Co., Pittsburgh, Pa.

Light, E. H., Draftsman Dayton Gas Light Co., Dayton, O.

Mancourt, Edward M., Manager Fairmont Coal Mining Co., Columbus, O.

McMillan, John, Manager Conneaut Gas Light and Fuel Co., Conneaut, O.

Marks, William D., President City Heat and Light Co., Fostoria, O.

Neely, J. D. S., General Superintendent Springfield Gas Light Co., and Lima Gas Light Co., Lima, O.

Parker, G. W., Agent Parker-Russell M. & M. Co., St. Louis, Mo.

Pattrell, C. D., Superintendent Mansfield Gas Light Co., and Electric Light Co., Mansfield, O.

Pelton, Frank K., Secretary and Treasurer Bowling Green Gas Co., Detroit, Mich.

Price, W. W., Manager Dayton Pipe and Cable Coup. Co., Dayton, O.

Schwarm, C. A., Superintendent Gas Department Lorain Gas Co., Lorain, O.

Steward, D. M., President D. M. Steward Manufacturing Co., Chattanooga, Tenn.

Steenbergen, Charles L., Assistant Superintendent Gallipolis Gas and Coke Company, Gallipolis, O.

Stukenborg, J. F., Salesman Schneider & Trenkamp Co., Cleveland, O.

Simpson, Joseph, General Sales Agent Portable Electric Power and Light Co., New York City.

Steward, Robert Bruce, Vice-President D. M. Steward Manufacturing Co., Chattanooga, Tenn.

Thompson, John A., Manager Lebanon Gas Co., Lebanon, O.

Wendler, B. F., Auditor Dayton Gas and Fuel Co., Dayton, O.

West, William D., Superintendent Marion Gas Co., Marion, O.

York, Geo. W., Secretary Alliance Gas and Electric Co., Cleveland, O.

Respectfully submitted for Executive Committee,

Dayton, O., March 20, 1901. T. C. Jones, Secretary.

On motion of Sterling F. Hayward, of New York, duly seconded, the report of the Executive Committee was adopted and ordered spread upon the minutes of the Association.

Election of New Members.

It was then moved by John D. McIlhenny, of Philadelphia, Pa., duly seconded and carried, that the Secretary cast the ballot of the Association for the election to membership in the Association of the applicants recommended by the Executive Committee in its report:

Secretary Jones:—Mr. President, it gives me great pleasure to comply with the motion just adopted, and I hereby cast the ballot of the Association for the election to membership of the applicants referred to, and declare them duly elected members of th Ohio Gas Light Association.

The President:—It is the desire of the Chair, and, I am sure, of all the older members present, that the gentlemen whose applications have been favorably acted upon and who are now active members of the Ohio Gas Light Association, will feel free to take an active part in these proceedings. The next report in order is the report of the Secretary and Treasurer.

REPORT OF SECRETARY AND TREASURER.

To the Members, the Ohio Gas Light Association:

GENTLEMEN :—I have the honor to present herewith the seventeenth annual report of the Secretary and Treasurer for the period between March 21, 1900, and March 20, 1901.

New members admitted at the sixteenth annual meeting....	33
Released from membership..........	11
Deaths	3
Active members at this date..........	211
Honorary members at this date..........	13
Badges on hand..........	1

Financial Report.—Receipts.

Balance from last year	$342 86
Received from dues	486 00
Received from initiations..........	155 00
Received from sale of badges..........	9 00
Received from gas journals for report of the sixteenth annual meeting	116 10
Total	$1,108 96

Expenditures.

Printing and stationery	$134 50
Postage	40 60
Expense of reporting sixteenth annual meeting..........	116 00
Secretary's salary sixteenth annual meeting..........	300 00
Expense of Executive Committee..........	46 56
Telegrams and telephones..........	28 08
Express	2 81
Badges	12 50
Balance on hand as per certified check	427 81
Total	$1,108 96

Respectfully submitted,

T. C. JONES, Secretary-Treasurer.

Approved:—C. W. ANDREWS, J. H. MAXON, Finance Committee.

On motion of Fred R. Persons, of Toledo, O., seconded and carried, the report of the Secretary and Treasurer was received, adopted and ordered spread on the minutes of the Association.

Letters of Regret.

PRESIDENT WHYSALL:—We have some letters of regret which the Secretary will now read.

THE SECRETARY:—I have received from the following gentlemen letters expressing regret at their inability to be present:

J. T. Mason, Milwaukee, Wis.; W. W. Goodwin, Philadelphia, Pa.; Alton S. Miller, New York City; A. C. Humphreys, New York City; W. M. Eaton, Jackson, Mich.; George G. Ramsdell, Philadelphia, Pa.; Paul Doty, Grand Rapids, Mich.; Walton Clark, Philadelphia, Pa.; A. P. Lathrop, St. Paul, Minn.; S. S. Stratton, Baltimore, Md.; D. J. Collins, Philadelphia, Pa.; A. B. Eaton, Philadelphia, Pa.; George H. Tayler, Warren, O., and Emil G. Schmidt, Sandusky, O.

Letters have also been received from the following Gas Association officers expressing their regret at not being able to be present:

J. B. Grimwood, Secretary Pacific Coast Gas Association, San Francisco, Cal.; Edward M. Pratt, President American Gas Light Association, Des Moines, Ia.; N. W. Gifford, Secretary New England Association of Gas Engineers, New Bedford, Mass., and Jas. W. Dunbar, Secretary Western Gas Association. Mr. Dunbar extends to the members of the Ohio Association a cordial invitation to attend the Western meeting at Louisville, May 15, 16 and 17, 1901.

The Chair then announced as the next order of business the

PRESIDENT'S ADDRESS.

GEORGE WHYSALL.

As we have an unusually large program, covering business and entertainment, it will be necessary for all to be prompt and expeditious, otherwise some of the good things in store for us will have to be omitted. I will consume but little time with my address, confining my remarks and suggestions to matters which, I trust, will meet with your approval.

Our meeting is again held in a city largely lighted by gas, due undoubtedly to the recognition by the municipal authorities of the many improvements in street gas lighting appliances and their reliability under all circumstances. Reports from a large number of cities indicate that gas is again in use very extensively

for street lighting, especially in residential and suburban districts, and at the present rate of progress the electric arc is rapidly moving to the rear.

It was predicted at our last meeting that gas producing materials would advance in price, and that there was a possibility of the decrease in value of by-products. These conditions have, to a certain extent, come about, and in some localities the cost per unit of production is higher than heretofore.

This being an age of pools and combines, I would suggest the advisability of the small companies at least combining in convenient groups for the purchasing of their materials and supplies, as well as disposing of their by-products. It is a well-known fact that a large buyer of any commodity has a decided advantage over the small consumer. I believe if this plan can be carried out it will effect a very material decrease in cost and increase in earnings, and while it is possibly not a matter for the Association to take up, I think the members individually would be justified in giving it some attention.

There is a determined effort all along the line to secure a larger volume of business, and while this has always been the policy of gas companies, it is now prosecuted with more diligence than ever.

As an aid in securing this result the Novelty Advertising Department was suggested by a prominent member of this Association; and as you become better acquainted with the methods and schemes suggested, the more interesting and deserving of support you will find it. It is intended to cover much of the ground hertofore taken up by papers too numerous to mention, and as nothing of the kind has been attempted by any other Gas Association, our pride in this organization must be such as to make it the success it deserves. The progress made in the short time the department has been in operation reflects great credit upon the gentleman who so kindly agreed to become the editor-in-chief.

The "Wrinkle Department" you will find unsually interesting, and this being our first attempt also in this line indicates that the Ohio Association is endeavoring to maintain its well-earned reputation throughout the country.

As the many papers and other contributions presented to this Association are of great value not only to the members thereof, but are also of interest to many others identified with the business, I would suggest that a committee be appointed to act with the Secretary in arranging for the publication of our proceedings in

book form. By publishing a volume each year for three years, each to cover a period of three years, we would soon have the proceedings of past meetings in print, and thereafter one volume every third year would be all that would be necessary. The expense of such publication could be partially borne by the sale of volumes at a reasonable figure to non-members desiring them. A greater portion of the expense, however, might be absorbed by setting aside a portion of each volume for advertising purposes. The compilation as above indicated would certainly be a valuable addition to the library of every member of this Association.

While the last year has not witnessed the introduction of any new methods of producing or consuming our product, there have been some installations of new types of generating plants in this part of the country. In our own state there has been erected, in the city of Hamilton, a by-product coke-oven plant, to which it will be well to turn our attention. That an Ohio Company should be the pioneer in introducing this method of carbonization in the Western country goes far to prove the proverbial "push" of our people. Information as to results obtained in the operation of this plant will undoubtedly be of much value to all, and it is to be regretted that the plant has not been in operation a sufficient length of time to enable the management to give out statistics.

Much has been said and written about acetylene gas, but we do not find it interfering in the least with the output of any of the gas companies in this state, and while to a certain extent it is of value for isolated houses, the many annoyances as to results obtained with an experimental plant in Indiana would be very interesting.

Our Association continues to grow in numbers, and the membership has long since exceeded the limits of the state, members of it being now scattered over almost the entire country, and I think it would be proper to give the Committee on the Next Place of Meeting considerable latitude. Indiana, on our west, is credited with a large number of gas companies, some of which are represented in this Association, and if some of our meetings could be held in that state the result would be the acquisition of a large number of new members. Pennsylvania is fairly well represented, and would no doubt be glad to have some of the meetings held within her borders.

Since the sixteenth annual meeting held at Columbus, death has claimed two very prominent members of this Association. I

refer to H. Wilkiemeyer, Vice-President and General Manager Evansville Gas and Electric Company, Evansville, Ind., who died November 20, 1900, and George Treadway Thompson, President and Treasurer Denver Gas and Electric Company, Denver Colo., who died October 1, 1900; and another member, Henry Ranshaw, President The Stacey Manufacturing Company, Cincinnati, O., died June 30, 1900.

Mr. Wilkiemeyer was President of this Association 11 years ago. He seldom missed a meeting, and when present never failed to take part in the proceedings, and freely give his counsel, advice and encouragement.

Mr. Thompson was active in everything pertaining to the profession, and he will be missed by his many friends, to whom he so willingly imparted information gathered at home and abroad.

Mr. Ranshaw was a retiring man, and seldom appeared publicly in the gas world. He had been connected with the Stacey Company since 1851.

A memorial will be prepared and offered by a committee appointed for the purpose.

Too much credit cannot be given our Secretary for the interesting program he has prepared for our consideration. Only by being in touch with him can one appreciate the enormous amount of work connected with a meeting of this kind.

Our thanks are due the gentlemen who have so kindly prepared papers for our consideration, as well as those who are providing for our entertainment.

For the honor of being chosen to preside at this meetting I sincerely thank you, and can only say that the position would be very difficult to fill without the ever ready and efficient aid of the Secretary, to whom we are all so much indebted for the large measure of success we enjoy.

C. W. Andrews:—Mr. Secretary, I move that a committee of three be appointed by you, to consider the recommendations contained in the President's address and make a report to this convention. (Seconded; carried.)

Secretary Jones:—I will appoint on that committee C. W. Andrews, of Hamilton, O.; John D. McIlhenny, of Philadelphia, Pa., and J. H. Maxon, of Gallipolis, O.

The President:—Gentlemen, the first paper on our program is

A GAS PUMPING STATION.

E. E. EYSENBACH.

The demand for natural gas is increasing, and the pressure in the fields continually decreasing. This condition of affairs has compelled natural gas companies for a number of years to use compressing pumps in order to increase the capacity of their pipe lines, and reduce the back pressure on the wells. The history of all the fields has been the same in this respect, and last winter our company at Columbus, getting its gas from the Sugar Grove district, found that it could not longer depend upon rock pressure to supply the demand, and the erection of a pumping station was decided upon. This station was erected about three miles southeast of Lancaster, and has been in operation since January, 1901. It is located in a cornfield about 500 feet from the pike. The site was chosen because it offers a good water supply, and is near the main gas lines leading to the city.

The work of compression is done by a 1,000 horse-power gas engine, directly connected to the gas compressor. The station consists of the main building, 80 x 30 feet, containing the engine and compressor; placed at one side of this is a smaller building containing a 10 horse-power engine used for starting the large one, an electric dynamo, gasometer tanks and regulators. Besides these, there is an office and telephone station, and a machine shop containing forge and pipe-threading machine. The buildings are all wooden frame structures, covered with corrugated iron. The main building contains a 10-ton traveling crane, used for erecting the engine. Electricity is used for lighting to avoid the danger of explosion should any breaks occur in the pipes or fittings. The engine foundation was built of concrete made up in the proportion of 1, 4, 6, cement, sand and broken limestone. It is 56 feet long, 16 feet wide and 7 feet 6 inches deep, containing over 200 yards of concrete. Near the bottom, and imbedded in the foundation were heavy oak planks and steel railroad rails. The foundation is practically one solid rock. Forty-six 2-inch foundation bolts 5 feet long were set in concrete and bedplates bolted to them.

The interesting feature of the station is the large horizontal gas engine. It was built by the Snow Steam Pump Works at Buffalo, designed by Mr. Klein, of the National Transit Works,

Oil City, Pa., and consists of four cylinders placed tandem, two on each side of the main shaft. The engine cylinders are 25 x 48 inches, and are placed axially in line. Their pistons are coupled to the main shaft crank pin by piston rods, crossheads and connecting rods. The gas compressor cylinders, 16 x 24 inches, are placed parallel to the engine cylinders, one on each side of the main shaft, and their pistons are driven from a crank having its pin 90 degrees from engine crane pin. As there are four gas cylinders, there is one impulse for each stroke, two for each revolution. The heavy work is done by a compressor at the end of its stroke, the pressure rising very quickly then. As the crank pin of the compressor is 90 degrees from the engine crank, the impulse from engine comes at a time when most needed, and when doing its work to best advantage; that is, when compressor is doing its heaviest work and engine crank is 90 degrees from center. The entire weight of the machine is 250 tons. The two flywheels, one on each side of the crank shaft, are 13 feet in diameter, and weigh 38,000 pounds each. The crank shaft, 19 x 3 feet 5 inches, weighs 14,400 pounds. The bed plate, the pillow blocks, the compressor and engine cylinders, and the crosshead guide all weigh from 6,000 pounds to 18,000 pounds, and gave not a little trouble when moving them over a cornfield in the middle of December. Owing to the rush of work at all of the big machine shops, the shipment of our pump was delayed more than six weeks, and arrived late in December after the fall rains had spoiled the roads.

The engine is started by an explosive mixture of gas and air, stored at 7 pounds pressure in a small tank located outside the main building. A small mixture compressor is used to fill this tank. The power of the engine is regulated by the amount of the charge admitted to the cylinders, the quality of the air and gas mixture remaining the same. The current for the igniters is furnished by a battery through an induction coil. The battery is charged at night when running the lighting plant. The gas used for running the engine is taken from the main line and reduced by several regulators to 1-ounce pressure. A 3-inch line carries the gas to the mixing chambers, of which there are two. Two 12-inch pipes extending from these to the outside of the building supply the air. The gas compressor cylinders are 16 x 24 inches, having 8-inch inlet and outlet connections. The outlet lines are laid in a creek for a distance of 400 feet to insure a complete cooling of the gas before re-entering the main lines. On account of

the rapid rise in temperature when compressing gas, good efficiency can only be obtained by compounding; that is, compressing in two or three stages, and cooling between the compressions. As yet we are using but one stage compression, but provision has been made for the use of two more cylinders, as soon as inlet pressures drop to a point where double compression becomes necessary. A number of 16-inch pipes will then be laid in the creek to serve as a condenser. The gas after leaving the first two cylinders will be cooled in these condensers before entering last two cylinders for second compression.

The pump is guaranteed to run at a speed of 120 revolutions per minute, and to deliver 12,000,000 cubic feet per 24 hours, taking gas at an inlet pressure of 100 pounds, and delivering it at 315 pounds absolute. Up to date it has been delivering 10,000,000 to 12,000,000 feet daily. A complete test will be made to determine both indicated horse-power of engine and actual horse-power delivered at compressor. The engine is only the second one ever built of this size, and it will be very interesting to know the amount of gas used per horse-power hour delivered at compressor.

Pumping stations naturally depend on gas for power, but when the gas is used under the boilers for making steam, much larger quantities are needed for doing the same work. As yet we have run only at light load, and efficiency is low, but from rough tests made we are not using 15 feet per horse-power hour. This is about 40 per cent. of the amount required to do the same work with steam. I see no reason why we should not get a brake horse-power hour on 10 feet of gas, and hope to be able to give authentic figures at some future date.

The entire work of erection was done in a rush, and during the cold weather we needed the pump so much that we have not found an opportunity for making some needed alterations, and we did not care to make any careful tests until we had everything in smooth running order.

To me the gas engine represents the only means by which we can hope to get any marked increase in efficiency in the conversion of heat into power, and I am keenly interested in results that we can obtain with the new toy.

DISCUSSION.

The President:—Gentlemen, you have listened to a very interesting paper, and it is now before the Association for discussion. I hope you will all feel free to express yourselves on the

subject under consideration, remembering that one of the most beneficial features of our annual gatherings is the full and extended interchange of opinions by the members present. I will call on Mr. James T. Lynn to open the discussion of Mr. Eysenbach's paper.

JAMES T. LYNN:—I do not know as I could say anything on this subject which would be of interest to the Association. I have had some experience in pumping gas, but have always done it with steam, using natural gas under the boiler and pumping with a steam pump, a pump manufactured by the Standard Oil Company at Oil City. I would like to ask if this cylinder takes gas at both ends of the cylinder and how often it takes it during a stroke?

MR. EYSENBACH:—It takes it at both ends.

MR. LYNN:—Twice during a revolution?

MR. EYSENBACH:—Yes, sir.

MR. LYNN:—But using it ordinarily, would it naturally take gas twice a stroke, or would it take gas just when necessary, the same as our old gas engines?

MR. EYSENBACH:—Do you mean at the compression side or engine?

MR. LYNN:—The engine side.

MR. EYSENBACH:—No. It will take a little gas just as needed.

ERNEST F. LLOYD:—It seems to me from the description of the engine, Mr. President, that it operates much on the principle of the Westinghouse, of throttling the mixture and losing the compression, thus getting a lower compression on a lighter load. That principle, I believe, is being carried out to a considerable extent by the Westinghouse people, but it does not seem to be favored so much abroad, where they are using large engines, from 750 to 1,000 horse-power, on blast furnace gases. They are using abroad the horizontal instead of the vertical type, which I presume this is. I would like to ask whether there has been any difficulty observed in taking a compressed mixture, explosive mixture, and passing it through the admission valve through the explosion cylinder? In case of back firing, it seems to me it would cause trouble.

MR. EYSENBACH:—No; I do not think the flame propagation is rapid enough to back fire. We have had no such trouble whatever.

MR. LLOYD:—Is the mixing cylinder under pressure?

MR. EYSENBACH:—Yes; under 70 pounds pressure.

Mr. Lloyd:—Then the engine compresses in the cylinder itself 70 pounds up to the firing point?

Mr. Eysenbach:—Yes.

Mr. Lloyd:—What is the compression used in firing the cylinder?

Mr. Eysenbach:—Hundred pounds; that is sufficient to start it.

Mr. Lloyd:—I mean in running the engine; in its regular operation?

Mr. Eysenbach:—One hundred pounds.

Mr. Lloyd:—And you have no difficulty through that valve at all?

Mr. Eysenbach:—No.

Mr. Lloyd:—There was an engine introduced some years ago in which there was a supplementary pump, which, I should judge, brought up the pressure in somewhat the same manner, and they found considerable difficulty with that. In case any leakage through the valve occurred, the storage tank would itself explode.

Mr. Eysenbach:—We have not had any trouble yet.

James T. Lynn:—I would like to ask at what pressure the gas goes into the mixing chamber?

Mr. Eysenbach:—One ounce.

Mr. Lynn:—And now you think you are using about 15 feet per horse-power?

Mr. Eysenbach:—Yes.

Mr. Lynn:—Is that actual horse-power or indicated?

Mr. Eysenbach:—That is actual. We have not taken any tests as yet.

Mr. Lynn:—The Westinghouse people are doing a little better than that in Detroit. They are running a number of gas engines in Detroit for electric lighting, direct connected, and they are developing one horse-power per 11 feet of natural gas, and they will give a guarantee to furnish one horse-power per 15 feet of artificial coal-gas.

Mr. Hayward:—What size engine?

Mr. Lynn:—Anything over 50 horse-power. I am figuring with them now for a 450 horse-power engine.

Mr. Schwarm:—How do you take care of the exhaust?

Mr. Eysenbach:—Through two 12-inch pipes.

Mr. Schwarm:—Does it make much noise.

Mr. Eysenbach:—Not so very much.

MR. SCHWARM:—Do you need mufflers on the pipes at all?

MR. EYSENBACH:—No; we do not need them out there, because there are no houses within a half mile.

MR. LLOYD:—The last speaker has referred to mufflers on gas engines. I should like to say, for the general information of those who are troubled with that problem, that there is no difficulty in absolutely silencing the exhaust from any size engine. We are running three engines in our shops in Ft. Wayne, and have experienced no difficulty whatever in silencing the exhaust. If you will take a horizontal cylinder for a 25-horse-power engine, about 2 feet in diameter and 12 feet long, fill it half full of water, bury it under ground, let the overflow from the engine run through it and turn the exhaust in on top and take the exhaust pipe out of the other end, you will have no difficulty with noise from your exhaust.

MR. ANDREWS:—In regard to muffling the exhaust, I find in using a larger Westinghouse engine (150 horse-power) that by running a part of the cooling water into the exhaust pipe, the noise can be practically overcome. It will form a steam vapor in there which will very effectually muffle the exhaust. It is a very simple way of taking care of it, and at the same time the water is carried off in the form of vapor or steam and it does not bother you.

THE PRESIDENT:—Is there or not a reduction in the volume of gas which escapes owing to this drop in temperature? Is it not possible the evaporation of the water decreases the volume of gas you are discharging at the same time?

MR. ANDREWS:—I think so. As the water vaporizes, it reduces the temperature of the exhaust and destroys the sharp report. In regard to the consumption of water in these engines I will say that we are using a circulating pump which takes water from the bottom of the holder and discharges it back at the surface. We keep that up the year round. This keeps the water in the holder warm enough in winter weather to prevent freezing and in the summer there is enough cool water at the bottom to keep the engine cool. It makes a very simple and efficient way of handling it. We have very bad water. As far as lime and magnesia are concerned the percentage is very high, and we have found it necessary to dissolve the scale with a little hydrochloric or muriatic acid, letting it stand in the cooling water space for a few hours. In this way we find that it does the work very effectually, and takes the sediment out very nicely.

Mr. Lloyd:—I do not want to monopolize this discussion, but in regard to the quantity of water necessary when using the tank for cooling, you will find about 25 or 30 gallons capacity in the standing tank per horse-power engine will furnish a sufficiently low temperature for circulation.

Mr. Whysall:—I presume the President can ask a few questions. Mr. Eysenbach, do you have any difficulty in starting the engine? How do you get rid of the load? How do you take care of the load in starting it?

Mr. Eysenbach:—Do you mean to get up speed in the first instance?

Mr. Whysall:—Yes.

Mr. Eysenbach:—We have but very little back pressure to start with.

President Whysall:—What I was getting at was this: Your engine is at rest, and you have a high initial pressure on your pump, the inlet and outlet pressure is the same for the first few revolutions; you have a very heavy load to move, do you not?

Mr. Eysenbach:—No.

President Whysall:—Do you start off with the pump ends empty or do you have a system of by-passes?

Mr. Eysenbach:—We have a system of by-passes which allows us to get up speed.

President Whysall:—Then the engine is started with no load to speak of.

Mr. Eysenbach:—Yes, sir.

President Whysall:—That is what I wanted to get at.

Mr. McIlhenny:—Mr. President, I move that a vote of thanks be tendered to Mr. Eysenbach for the valuable paper which he has prepared and presented to us.

The motion being duly seconded, was then carried.

President Whysall:—We will now listen to a paper by Mr. C. W. Andrews, of Hamilton, O., on the subject, "More About Concrete Tanks."

Mr. Andrews then read as follows, his paper upon

MORE ABOUT CONCRETE TANKS.

C. W. ANDREWS.

The writer had the pleasure of presenting at the fifteenth annual meeting of this Association a few notes on the construction of a concrete gas holder. Since that time Mr. McDonald, of Louisville, has constructed a much larger tank, and I have also

had the opportunity of building a second one. It, therefore, was suggested by your Secretary, that I give you the results obtained in this later work. Before doing so, however, I wish to say that the concrete tank built in 1897 gives practically no leakage, and shows no signs of deterioration, and probably will not do so, as Portland cement concrete becomes harder with age, especially under water, while many brick, if not vitrified, will materially soften after several years of immersion.

The holder built by Mr. McDonald has proven successful, although built with Louisville cement, which construction I do not advocate, nor do I think that Mr. McDonald would repeat his use of the same, as the difference in the results obtained, and especially in view of the rapidly increasing manufacture of domestic Portland cement, with its consequent reduction in price, more than compensates for the additional cost.

We followed our previous practice in using clean gravel, although it is not necessary in this case to wash it. The tank was somewhat deeper, it being 25 feet deep in the clear by 53 feet inside diameter, extending 10 feet above the surrounding grade. The ground will be banked up about 5 feet, thus leaving approximately 5 feet exposed; this was necessary on account of the water level being only 19 feet below the grade level. The walls were made somewhat heavier than would have been the case had the whole tank been below the ground, they being 30 inches thick at the bottom and 23 inches at the top.

An entirely different construction was used for the forms. The inside form was built of 14-foot vertical dressed boards nailed to four concrete rings which were built up two thicknesses of inch boards, sawed to the circle. The outside form was constructed in a similar manner, thus forming two concentric cylinders separated by the required thickness of the walls, and 14 feet high. The cast-iron sockets for fastening the wall plates were bolted to the boards in their exact location, thus doing away with any trouble in regard to their alignment. Mixing boards 12 feet square were arranged around the excavation, their inner ends supported on the outer form and their outer ends on the banks. These boards were connected by wheeling runs, so that the wheelers could make continuous trips to and from the gravel pile without interference; from this it will be noted that the concrete was shoveled directly from the boards into the form instead of being wheeled. This was

found to be a decided saving, as much larger loads of gravel than of concrete were wheeled, and loss of cement by spilling was prevented.

After the walls were raised up 13 feet, the forms were cut into sections about 20 feet long, and raised vertically by a light derrick; they were then supported and braced from below with a 2 x 4 studding. This process was repeated until the two forms were raised to their new positions. The forms were then accurately centered, and the mixing boards raised on trestles. A substantial run connecting the boards with each other, and with an inclined run extending to the gravel pile, was then constructed. By this arrangement no difficulty was experienced in handling the materials expediously.

It is desirable to reduce the height of the inner cone, as the strains in the concrete bottom, due to the varying pressures and settlements, are very great, and in many cases result in cracking around the top of the cone as well as at the bottom of the well.

In conclusion, I desire to note a suggestion which our friend, Mr. McDonald, made in regard to the separation of the concrete surrounding the inlet and outlet pipes from the tank proper. As will readily be seen, when the tank settles, as is usually the case, the pipes form a girder tending to uphold that portion of the wall directly above them: this is, of course, impossible, and often results in cracked inlet or outlet pipes. He suggests that a layer of sand, say 6 inches thick, be interposed betwen the two masses, thus doing away with any direct contact.

DISCUSSION.

The President:—Gentlemen, the paper is now before you.

Mr. Schwarm:—I would like to ask Mr. Andrews if he knows the comparative cost between this form of construction and the steel tank?

Mr. Andrews:—I have not taken it up at this time on account of the fact that steel is much higher than it was in 1897. At that time I figured it out and there was a decided saving in favor of this method. I would say, however, that conditions would very materially govern the cost. For instance, if gravel or broken stone is difficult to obtain, and cement is high in price, the difference might be reduced to a very small figure.

Mr. Schwarm:—Do you know about the percentage of saving?

MR. ANDREWS:—At that time (which was in 1897), I think the saving was in the neighborhood of about 20 per cent.

GENERAL HARBISON:—Mr. President, I would like to ask Mr. Andrews, if you please, whether he has experienced any difficulty at all in the cracking at the tank wall caused by the lack of uniformity in the foundation?

MR. ANDREWS:—I would say in our old tank we have experienced no difficulty in the way of cracking as yet of any moment. The only cracks I can find have appeared in the coating which is put on top for the finishing coat. That cracking was probably one inch in depth, but the walls have shown no signs of cracking whatever. It has been in use three years now and the leakage has decreased to practically nothing, so that I judge no further cracking has taken place below.

GENERAL HARBISON:—I apprehend, Mr. President, that generally in the location of gas-works in the cities it may be found that there is an irregularity in the condition of the soil at the bottom of the tank, and that danger may be encountered from the cracking of the concrete walls. In our city we have had varied experiences of that nature. We began in 1849 building our first tank, 60 feet in diameter, 20 feet in depth, and the contractor was able to make a tight tank. It was built of brick laid for Portland cement, but the tanks built after that were not successful as to being tight. Perhaps that was because the parties who built the original tank had experience; whereas, the youth who came in to take care of the work a little later, did not have so much experience and did not know how to have the work done. We have had our tanks—one particularly—built by a contractor from Philadelphia, who was highly recommended to us, and the day it was filled with water it split from top to bottom, leaving a space 12 feet between the tank wall and the retaining wall fronting on the river. It cost us about $1,500 to dig out that 12 feet of space and fill it with concrete and make it tight. It held for a few years and then it would open up after every freshet. We have only a rise and fall of 27 feet in our water lever from low to high-water. We are not so favorably situated as our friends in Cincinnati, who can look for a rise and fall of 60 to 70 feet without any trouble, but our variation of 27 feet is sufficient for all practical uses so far as we are concerned. In repairing these tanks, it has been a problem how to stop the leaks, and the one I just told you about, which occurred immediately after it was built, was relined with

a 4-inch brick wall, chipping off the entire surface of the old brick so that the cement would adhere. The 4-inch wall was anchored into the old work, and we succeeded in making a perfectly tight job cf it. It was not built after the plan of architecture of my friend Persons, but we succeeded in making a good, compact job of it in this way. Since that, we have steel-lined two tanks that we built of brick and could not otherwise make tight. Five or six years ago, we built a steel tank, 30 feet in depth, by 100 feet in diameter, and I am glad to be able to say that it was a perfectly tight job. All the water that comes from it, I think, is simply through evaporation. It is 20 feet below the ground level and 10 feet above. It costs a trifle more. However, taking Mr. Andrews' figures that it costs 20 per cent. more—I presume he knows and I don't—I would be willing to pay the 20 per cent. additional in order to have a steel tank, which I know is perfectly tight, rather than to have a concrete, or brick tank, liable to go pieces later on. It is a difficult problem for the gas man to overcome, when he has a leaky tank.

The President then called upon John R. Lynn, of Portsmouth, O., who said:

Mr. President, I have had no experience in the building of concrete tanks, but I should judge that the nature of the soil would have very much to do with it, whether or not the tank should be made tight. I removed a holder a short time ago where a concrete tank had been in use, I should judge, for 38 or 40 years, and the tank was still perfectly tight. The soil around the tank was rather moist, but we could detect no seepage at all.

The President:—Mr. Joseph Light, could you give us some information about concrete tanks?

Mr. Light:—Mr. President and members, I have had no experience with concrete tanks. If I had a tank to build, I believe I would prefer to build it with brick or steel, if it did cost a little more.

The Chair then called on G. N. Clapp, who said:

I have had no experience with concrete tanks, but I always believe in being on the safe side. I built a tank last spring—a small one, however—but it was perfectly tight. We noticed no leakage except evaporation. I am now contemplating building another tank. I am very much interested to know the experience of the different members with reference to concrete, but would like to know the difference in cost, if Mr. Andrews could tell us, of the brick and concrete tanks.

MR. ANDREWS:—I would say that I have always looked at it that there were certain locations where a steel tank was preferable beyond all question to any other kind. What I have contended for is that concrete is preferable to brick especially, not necessarily so much as compared to the steel tank. So far as I could figure out, the saving in the concrete tank, as compared with a brick tank, is fully 50 per cent., provided you get your gravel or broken stone at a reasonable figure. As to the steel tank, the conditions are such that the cost is a very close approximation under certain circumstances. Where the foundation is not as satisfactory as you might desire, there is certainly no reason why the steel tank should not be used. I prefer it myself to the concrete tank, provided you cannot get good foundations. I have always felt where the foundations were always satisfactory, you are more safe if you have your tank down in the ground. Then there is no further deterioration or expense about it after you once get it tight; whereas, with the steel tank, it has to be painted and a certain amount of work expended upon it in that way. But as between a brick tank and a concrete tank, there is no question that a very large saving can be made by constructing a concrete tank.

E. C. BAKER, of Cleveland, O.: I am not a member of the Association, but I am interested in the cement question, and have had some experience in Portland cement. I would like to say just a few words in regard to Portland cement holders. The Government in its public works, in a great many instances, has done away with dimension stone for bridges, bridge piers, dams and abutments, and is now using Portland cement concrete. It makes a more solid and stronger and more durable job. Instead, however, of going down to bed rock in many instances they drive piles, which I suppose could be done in the case of gas holders. So far as cracking is concerned, Portland cement concrete is a great deal stronger than brick construction, if mixed in proper proportions. It would not be so liable to crack and is much better than brick or stone. It is more durable and not so liable to leak. Portland cement concrete would not crack, where brick or Louisville cement concrete would crack. It costs much less to build concrete than it would brick or steel or stone. Of course it depends somewhat on the cost of gravel. I was reading an article last night with reference to the construction of an immense Government dam at a lake near the head of the Mississippi River. They

had been working at it for over two years using Portland cement concrete. There they washed every particle of gravel and got clean sand. Unless you have clean gravel and sand, you have to have a larger proportion of cement. The general proportion which the Government uses is six parts of crushed stone, three parts of sand and one part of cement. The stone and gravel should be thoroughly washed, and both the stone and sand should be very sharp and very free from loam.

MR. LLOYD:—I would like to ask the last speaker the size mesh to which that stone was broken in Government work.

MR. BAKER:—The stone used in the concrete work should not be larger than would pass a one-inch ring. In every cubic yard of concrete, they lay eight bowlders or "nigger heads," but of course, that could not be done in the use of concrete for tanks; the wall would not be thick enough. These bowlders in the larger works are laid carefully in the center so that they will not be exposed.

MR. CLAPP:—I would like to ask Mr. Andrews if he made any preparation for the foundation around the walls by tamping or anything like that. I believe you have gravel for your foundations.

MR. ANDREWS:—In excavating for foundations, we have been very careful not to disturb the gravel below the actual grade of the concrete. That is, we have used no back filling whatever. As we had a good bed of gravel for foundation, we took no further precautions in the way of tamping, but should there have been any excavating below that, we certainly should have done so.

SERCETARY JONES:—I move, Mr. President, that a hearty vote of thanks be extended to Mr. Andrews for his very valuable paper.

JAMES T. LYNN:—I would second that motion, Mr. President, but before it is put I would like to ask Mr. Andrews how much footing he put in below his wall or ring.

MR. ANDREWS:—In our new holder, we extended the footing course about 1.5 feet beyond the outside wall and into the foot of the cone. This block was put in about 12 or 14 inches thick and allowed to harden before the side walls were started. This made a very wide footing course.

The motion to extend a vote of thanks to Mr. Andrews was then put and carried.

THE PRESIDENT:—Mr. Somerville, we should like to have a few remarks from you. You are a little late coming in, but at the same time I know the members would like to hear from you.

Mr. Somerville:—It is very kind of you, Mr. President; I thank you for the courtesy extended. It has given me great pleasure to be here, and I am sure I shall reap much profit and enjoyment from these proceedings. It is the first time that I have had the pleasure of coming to the Ohio meeting. I have always understood that it is, and indeed, it has a reputation of being called, a working association. In other words, I have been informed that the President, when he calls upon a member who has nothing to say, is in the habit of ringing the bell on him, which I think is a good plan. I have nothing further to say at this time, except to express my gratification in seeing so many old faces which I have met at the meetings of the Western Association, and to add that I shall be glad to listen to your very valuable papers and interesting discussions. I thank you.

QUESTION BOX.

The President:—I think we might dispose of Question 5 of the question box in this connection. Question 5—"What is the best way to stop a leak in the bottom head of a steel holder tank 50 feet in diameter, location of leak unknown, stream of water of 2-inch pipe size coming through foundation. Holder rests on rock foundation, with 2 inches of sand bedding?"

John R. Lynn:—I think if a man has that kind of leak, about the first thing he'd better do would be to find out just where the leak is.

General Harbison:—Our steel tank has not a bottom head. We do not put heads in the bottom. Ours has a bottom of concrete, and I will advise a man who has a leaking head in the bottom of his tank to empty out the water and put on 4 or 5 inches in depth of good concrete, spread over the bottom of his tank to stop the leak. I want to say one word in regard to the cost of a steel tank in keeping it in repair. For the last six or seven years we have been making a large portion of our whole volume of gas water-gas. As we all know, the tar from water-gas is very much thinner than coal-gas, and a laborer with a white-wash brush will cover a large amount of surface as paint with water-gas tar. They who have not tried it, if they do, in my opinion, will find that there is nothing that is as cheap and serviceable. We paint our tank above ground with water-gas tar, and our holders with water-gas tar, and paint the walls of all the buildings probably 2

or 3 feet above ground with the water-gas tar, and the stone walls around the two sides of the works up to 2 or 3 feet above the surface, are painted on the inside with water-gas tar, the balance of the stone walls being whitewashed. We do not do this oftener than once in three years; and where any of the walls are bricked above the surface of the ground on account of the surface having been raised, so as to get out of the water, since the buildings were erected, we have dug down 6 inches below the surface of the ground a foot wide and saturated the brickwork with coal-tar, and for 3 inches above the surface of the ground, which prevents any moisture from working into the wall. In this way it does not cost any money, practically speaking, to protect the buildings. I have brought a section with me, which I will be pleased to exhibit, and I hope some member will interrogate me with reference to it, if it is not sufficiently self-explanatory.

PRESIDENT WHYSALL:—Question 3—"How many kilowatts can one obtain from 1,000 of gas in a gas engine, (*a*) at full power, (*b*) at ¾ power, (*c*) at ½ power, (*d*) at ¼ power?"

MR. ANDREWS:—I was just making some figures here in connection with that matter. The first point I would call attention to is what kind of gas is meant? It is rather difficult to answer this question intelligently, as there is no information given as to the quality of gas, whether 600 or 1,000 heat-units is to be used. I would say that using ordinary illuminating gas, you would obtain at full load approximately 30 kilowatts to 1,000 feet of gas. The quantity obtained at ¾, ½ and ¼ power would be determined entirely by the efficiency of the engine or generator under these conditions.

PRESIDENT WHYSALL:—Question 6—"What is the thermal value of acetylene gas (C_2H_2)?"

MR. EYSENBACH:—Does that mean 1 pound or 1 foot? It is about 1,400 heat units per foot.

PRESIDENT WHYSALL:—Question 7—"What is the average mean horizontal candle-power of a flat-flame burner on 20 candle-power gas under ordinary conditions such as exist with consumers?"

MR. CHOLLAR:—If I would make a guess at it, I would say about 10 candles as an average.

MR. LYNN:—Is that on a consumption of about 5 feet per hour?

Mr. Chollar:—Yes, somewhere in that neighborhood, I think.

President Whysall:—Question 8—"Has any progress been recently made towards successfully reburning spent lime?" Mr. Chollar, can you answer that question?

Mr. Chollar:—I have known of some places where they have done that, but that was years ago in St. Louis, Mo., where the lime was spent over again, but I have not been able to see any reason why they should do it when you can get the limestone almost for nothing. Why need do that when the new limestone can be obtained so cheaply? I have never known it to be done at a profit, although possibly it might have been done where there was no limestone to be readily obtained.

General Harbison:—I would like to ask whether any member from his experience knows what it costs to burn lime over again per bushel. For instance, if a party were using oyster-shell lime, whether it would pay him to reburn it if lime were worth 10 or 12 cents per bushel.

Mr. Chollar:—I cannot answer that question with any degree of precision. I think where I have seen it done, it has been on account of the scarcity of limestone; the lime had to be hauled a long distance and no limestone near the point could be obtained cheaply enough. I think it has been in such instances where attempts have been made to reburn spent lime.

President Whysall:—Question 10—"In concentrating ammoniacal liquor, would it be advisable to use the cream of lime to liberate the fixed ammonia, and what percentage increase in yield of NH_3 would be obtained? Where and how should it be admitted to the concentrating column of the Stroh and Osius type?"

Nathan G. Leakey:—I have very little information on that, Mr. President. Concentrating the liquor, it will be all right to use the lime in large works, but in a small works I would not advise it. The percentage of ammonia there obtained would depend altogether on the amount of fixed ammonia.

Mr. Eysenbach:—I would like to say, in tests I have made, the fixed ammonia runs so low, as a rule, that it would not do in a small works. We use lime, and the fixed ammonia runs about 0.25 to 0.5 per cent.

PRESIDENT WHYSALL:—There is another question which has not been answered, and that is, "Where and how should it be admitted to concentrating column of the Stroh and Osius type?" Mr. Leakey, I will call on you to answer that question.

MR. LEAKEY:—I may say, Mr. President, that that also differs with different sizes of concentrators. Some of them are not built for the use of lime, but in the large concentrators the lime is admitted through a perforated pipe in the top square section of the apparatus; that is in the Stroh and Ossius type. As to other makes I can't answer for. As I have said before, in the different size concentrators the use of lime would vary. In a small size works, carbonizing less than 7,000 tons, it would hardly pay to use lime.

PRESIDENT WHYSALL:—Question 11—"What causes the heavy black deposit found in house and service pipes?

MR. EYSENBACH:—I would like to say that I asked that question, and I think that I had better describe the deposit which I found, as I would like to know if any one else has found the same. I wrote to Mr. Chollar about it last spring, and I found that he has had some trouble of the same kind. This is a peculiar black deposit. I have analyzed it and found it to be from 50 to 60 per cent. of iron oxide. In examining the pipes where we get these deposits, they appear perfectly smooth and clear, so that I do not believe it is rust; and yet I cannot account for it in any other way. From what I know of iron carbonyl, it does not deposit iron unless it is heated to a certain temperature, and yet it strikes me that it comes from the purifiers in some way. I think iron carbonyl has something to do with it.

JOHN R. LYNN:—Was that coal-gas?

MR. EYSENBACH:—Coal-gas.

MR. LYNN:—New pipes or old pipes?

MR. EYSENBACH:—Comparatively new pipes, not over five years old.

MR. LYNN:—If it were new pipes that Mr. Eysenbach has reference to, it might have been a lot of scale inside the pipes when they were placed there.

The Association then adjourned until 2 P. M. of the same day.

First Day.—Afternoon Session.

The Association met at 2 P. M.

The President:—The next order of business is a paper entitled "Some Observations, Pessimistic and Otherwise," by Charles R. Faben, Jr., of Toledo, O. I regret to say that Mr. Faben is ill, and will be unable to be with us. Mr. Persons has very kindly consented to read the paper:

SOME OBSERVATIONS, PESSIMISTIC AND OTHERWISE.

CHARLES R. FABEN, JR.

The proper committee of the Ohio Gas Light Association has assigned to me the duty of presenting some thoughts anent the subject of the existing state and future prospects of the gas industry. It further indicated to me that certain pessimistically inclined members of the Association were disposed to forecast rather an unpromising horoscope for the future of the gas business generally.

In view of the fact that I am without figures and other reliable data to sustain any fixed position in the premises, or to enable me to make comparisons between different managements in different situations, I must therefore rely entirely upon my personal experience and observations of travel for guidance, and the statements that are to follow must be very general in their character, in fact, mere glittering generalities.

The Century Dictionary defines pessimism as the doctrine which teaches that the world is the worst possible. The tendency to exaggerate in thought the evils of life, or to look only upon the dark side; a melancholy or depressing spirit or view of life. The pessimist, therefore, is one who accepts the metaphysical doctrine of pessimism. The same authority defines optimism as being the metaphysical doctrine of "Leibnitz," that the existing universe is the best of all possible universes—the belief or disposition to believe that whatever exists is right and good, in some inscrutable way, in spite of all observations to the contrary. The optimist, therefore, is one who believes in the metaphysical doctrine of optimism. Pessimism is the converse of optimism, as all of us well know.

The pessimist, in a spirit and mind filled with alarm, the same in degree bordering on desperation, makes a loud cry, and seeming at the same time to gather some measure of comfort from the feeling and thought that possesses him at the moment, makes such a declaration as this: "How dark and dreary this old world is! The future presents no ray of hope. Everything is out of tune. Nature itself is wrongly ordered, for as it now exists, we experience only a few hours of bright sunshine in each day, yet the same is encompassed between two long, dark, dreary nights."

The optimist, in turn, while regarding the same scene and situaction, views such a different picture. Filled as he is with bright thoughts of the present, and also charged to overflowing with bright visions of the good things that the future holds in store for him, and with face radiant, eyes bright, he, with equally loud voice, vigorous in tone, yet tinged with the seriousness that conviction always brings, exultantly exclaims: "How good and beautiful this world and life are! Two bright, glorious days in quick succession, with only one short interval of night season between."

These two extremes, yet in various shades and degrees, represent all the types of human mind and fancy as we meet them in our daily lives.

Laurence Sterne tersely stated his mind on pessimism when he wrote these words: "I pity the man who can travel from Dan to Beersheba, and cry, ' 'Tis all barren.' " It matters not whether we consider persons who are producers or consumers, the buyers or sellers, they are sure to make the impress of their mind and feeling manifest in the very atmosphere of their presence, and in degree, quite in accordance with the strength of character, personality, magnetic influence, or by any other term you may choose to use to define the power or influence they may possess to control the judgment of others.

The main thought expressed in the foregoing may not appeal at first as being apropos, or capable of wide application by such a gathering of persons as are here assembled. Other thoughts, and subjects of a more practical nature, in particular those which possess properties of a physical nature, would seem to be more fitting for consideration and discussion by such a gathering, yet you will pardon me if I make a suggestion here and now, *i. e.*, that each one of us examine ourselves carefully, and fully satisfy ourselves as to which of the foregoing defined doctrines do we most strictly

adhere, and in which school of thinkers are we best fitted to occupy a place, or hold a position.

With this question fully determined and established, it will not be difficult to quite as clearly determine the measure and degree of genuine success that may have attended the efforts of each one, in his particular field of usefulness.

The foregoing statements are very general in character, yet they are susceptible of being applied with much force in the conduct of the business of which we, now in annual session, claim to be representatives. Among our members are enrolled a full variety of the useful persons necessary to the successful operation of gas properties. The list comprehends the entire category of useful factors of the industry, from that of presidents of gas companies on down through the entire list, to that of good handy workmen generally employed about the works of the various gas companies here represented. Yet it is to the managers and general managers of these various corporations that I particularly desire to address myself at this time.

The manager or management, as the case may be, should, first of all, be thoroughly committed to the merit of the proposition, *i. e.*, that the gas business is right as a business proposition, and that the product of their works is a much needed commodity in the community in which they operate. The wise, prudent and successful manager or management, therefore, because of strong faith and belief in the merit of the proposition, will be strictly loyal to the same at all times and in all places. They will surround themselves with other persons equally loyal, not to them alone, but likewise to the industry which they represent.

Certain practices, through long experience in matters and affairs of a business nature, such practices always yielding like results, are now regarded as an established precedent. To state the matter more tersely, one might say, "business is business." The practices which obtain in matters of a social nature may be used to illustrate the point in question. For instance, society, as governed and administered by its adherents and devotees, has evolved certain rules and practices, that in effect are quite as rigid and exacting in their demands as may be found common in practice in large mercantile establishments. For instance, if you have no needs nor use for society, society in turn has no needs nor use for you. You are simply dropped from the list of social beings.

The analogy is quite clear, *i. e.*: If you are engaged in some particular line of business in which you have not abundant faith, or if it be that you have just a little faith, the business world will at once, and society in general will very soon thereafter, accept your estimate of the enterprise in which you are engaged. They have a perfect right to assume that you are entirely familiar with the venture in question, and furthermore that your judgment is mature.

Inversely, then, if you have an abundance of faith, and your venture has true merit to sustain it before would-be patrons, you will be sure to win, for the business world, and society generally, will quite as readily accept your report of the affair that seems to concern you most. Faith, Confidence and Merit, are three cardinal virtues in all business affairs and enterprises generally, but they will not stand long alone, if not well and strongly supported by proper business methods. If at any time it be discovered that the method then in practice be faulty, it must needs be corrected forthwith. I repeat it. It must be corrected forthwith, and must also be re-adjusted or corrected from time to time, quite as often as it may become necessary, in order to promptly adjust the same to change of conditions and circumstances attending.

Never wait to be forced into a new or strange position, the choice of which was made by another, but rather, if possible, by your alertness, and the judicious use of such foresight as you may be enabled to bring to your aid and purposes, move yourself into some new position of your own selection, and by so doing, you will doubtless receive the admiration, if not the commendation of your erstwhile rival, not to mention the commendation of your friends, among whom should be numbered those to whom you are directly responsible, in a financial way at least, for your conduct, and exercise of cool judgment.

When I regard in retrospect the methods and practices that obtained during the early years of my experience in the gas business, and in particular when I compare such with existing practices and general policy of the management of the company that I represent, it hardly seems possible that we were enabled to sustain ourselves in business under such a narrow, contracted, nearsighted policy.

At the time I entered the service of my present employers (1868), the minimum selling rate for illuminating gas to private consumers was $3 per 1,000 cubic feet. To the city of Toledo, for

lighting public buildings, and also for gas consúmed by street lamps, $2.25 was the selling price.

The charge made for erecting street lamps complete, in readiness for use, was $40 each. An additional charge of $5 per annum per each lamp-post in use, to cover the cost of lighting, extinguishing, cleaning and keeping same in proper repair, was also made.

Service connections, connecting our system of street mains with would-be consumers of gas (generally 0.75 inch in size), were laid from the street main to line of private property abutting, at the expense of the gas company, but for all service pipe, from line of street to consumer's meter, a uniform charge of 35 cents per lineal foot of pipe furnished, was charged to the property owner.

The necessary "meter connections" were also paid for by the property owners, and were regarded as a necessary fixture for the owner to furnish. The charge for a 3-light set of meter connections was $4, and all the larger size connections were sold at a price very much higher in proportion. Meter rent was charged in all cases wherein the aggregate of all bills rendered for gas consumed during the preceding year did not amount to the sum of $3. The meter rent charge was $3, and was in addition to such sums of money said consumer may have paid for gas consumed during the term aforesaid.

The company took little or no interest in the matter of gas supply beyond the outlet side of consumers' meters. Any fault or defect in house pipes, fixtures or burners was an affair in which the gas company seemed not to have any direct interest. It was merely an affair or incident in which the owner or occupant of the property on one hand, and some local gas fitter on the other, were the only parties in interest. It in no wise was an affair that particularly concerned us. Our duty, as then understood, was to manufacture and deliver gas through the consumer's meter. The use that was to be made of gas after passing through the meter, whether in its use it was to be consumed economically or wastefully; whether or not such devices then employed to consume the gas were in order so as to render good service for the purpose intended, was beyond the pale of duty on the part of the corporation supplying consumers with gas.

Frost in service pipes was a source of annoyance to the gas consumer, yet at the same time, it formed another source of revenue to the gas company, since it made a uniform charge of 50

cents against the consumer for each alcohol thaw administered. I have still in mind cases where the charge for "alcohol thaws" represented the major portion of the gas bill rendered for some of the heavy winter months.

Some consumers would prefer to wait until climatic changes would work a remedy in their particular case. It never seemed to enter our minds that we thereby were the losers, having defeated ourselves in the matter of our greatest source of revenue. *i. e.,* the sale of gas.

All this is now changed, and happily so. Gradually, and by easy stages, change after change, both in the matter of price charged for gas, as well as in all other practices and methods of conducting our industry, has been wrought and brought into common practice, until at present writing, I regard it that we are now more fully occupying the real sphere of usefulness for which we were incorporated by the great State of Ohio, and later given life, through the medium of the franchise rights conferred upon us by the proper authorities of our city.

They conveyed to, and vested in us, the right, power and privilege to serve the public with gas. In the conduct of our affairs as a corporation, we have been faithful in one phase at least, *i. e.,* we have always served each and all alike. The price per unit of service has always been the same to all private consumers of the company during any particular term of our operation.

At the beginning, and during the earlier portion of our experiences in conducting the gas business in our city, illuminating gas was regarded, in general terms, as being a species of luxury, and in no wise a necessity. To-day, however, illuminating gas has come to be regarded as a public necessity, and in nowise a luxury, and because of this change of opinion or estimate that has been put upon the commodity we vend, correspondingly great changes must have been wrought into the practices of the gas company or management which would conduct a successful business in a given locality.

To convey to you some idea of the change in methods and practice that obtains with us; compared with former times, of which I have previously given you an outline, I will cite the following statements of fact:

Gas is now being sold at 95 cents per 1,000 cubic feet for illuminating purposes, and for all domestic and industrial fuel purposes, at 70 cents per 1,000 cubic feet, when measured separately from that used for lighting purposes.

Service pipes (usually 1.5 inches in diameter) and likewise meter connections are installed without cost to the owner of the property. They remain the property of the company, by proper form of release executed by the property owner. In other words, it does not cost a would-be gas consumer anything to become a patron of our company.

House pipes, fixtures and burners are of special interest to us, and receive from us every attention necessary to insure good service to our patrons. Gas stoves, ranges, grates, water heaters, etc., are connected in place with suitable gas piping (without cost to consumer), to enable would-be patrons to avail themselves of the fuel rate charged for gas, when same is measured separately from that sold for illuminating purposes, as before stated.

A suitable and proper form of release of the piping so installed is executed by the house-owner in each case, and coupled with the same, we hold the privilege to maintain the piping in place, or to remove the same at any time, as we may decide.

In all business places, we now make yearly contracts (under proper and suitable conditions) agreeing to install and maintain any required number of incandescent gas lamps for regular use, to properly illuminate the premises, and this without cost to the consumer, other than the payment of bills rendered for gas consumed.

From the foregoing, it is clearly evident that the present policy of our company is most liberal in its general terms, and especially favorable to would-be patrons. The liberality of our present practice is made all the more manifest when compared with methods and practices employed by us quite 30 years ago.

In times past, gas companies were generally on the alert to secure the service of some honest, capable person, who by his particular methods, and by close application to his work, would secure the highest efficiency in gas product from a given amount of material used. In other words, the qualifications of the person who could manufacture gas cheaply, was the sort of talent that was in greatest demand by the then existing gas companies.

The successful gas companies of modern times, however, are on the alert to secure the services of persons who have all the above described qualities, but in addition thereto, are demanding the further quality and talent, to-wit, a person who can secure the maximum gas sales, for it is in the large volume of gas sold in a given locality, and not alone the low cost of production per unit

of volume of gas produced at the works, that yields true profit to the owners of gas properties.

Your committee advised me, as expressed in the opening lines of this paper, that certain members of our Association were rather pessimistic in their views concerning the future of the gas industry. That this is true does not in the least surprise me, when I call to mind situations that it has been my privilege to view in times past. I will cite a case in point to illustrate my meaning.

During a vacation period enjoyed by the writer within the past few seasons, it was his pleasure to pass a few days in a small city. It was situated, well, it makes no difference; but I promise to confine myself to facts, so that the location is immaterial. During my stay in the city, I met in a social manner the President of the local company, as did I also the Secretary and Superintendent of the company in question.

The President of the gas company was a professional man, and in successful practice. The Secretary and Superintendent was also in business in the clty. He had an office in which he carried on a brokerage business, with real estate and insurance added thereto. By arrangement with the local gas company, he kept their accounts, and also devoted some of his time to the working interests of the aforesaid company. Neither of these gentlemen were conversant with the gas business generally, nor did they mix or mingle with men who were. Association such as ours had never been graced by their presence, nor indeed had any of their employes been so favored.

The practical portion of their enterprise was conducted by a good, faithful employe, who had long been in their service. Among other duties required of him were such items as the following:

The laying of mains and services, pumping of drips, taking indexing, attending to complaints, setting and removing meters, etc., the remaining portion of his time being applied in some useful manner about the works of the company.

The company in question was no new concern, but rather had been in operation for more than 35 years. During its life the city had grown, both in wealth and population, very materially. Indeed, it was a very pretty, enterprising place, in general appearance. The streets were generally paved, the majority of which, I believe, did not contain a single foot of gas main. I saw large residences that were not even piped for gas, and they were not of recent construction, yet located on streets below the surface of

which the system of distributing mains, owned by the local gas company, had been in place for many seasons prior to the erection of such residences.

The gas company referred to laid service connections from the main pipe to line of curb. The remaining portion, *i. e.*, from line of curb to consumer's meter, was attended to by the local gas fitters, at the expense of the property owner. The pipe commonly used for connections was 0.5 inch in diameter of opening, with the result, that the supply of gas was insufficient, and the service rendered was faulty generally.

The company in question did not possess a meter prover. Occasionally it would resort to testing one gas meter by passing gas through two meters connected in series, and assume that one of the two in series was "correct," for its purposes. In general practice, however, it was forced to rely upon the "size of the gas bill" rendered, as being an index as to whether the gas meter in question was properly performing its duty.

Quite all of the consumers' meters owned by the company were connected in place ready for service. When a consumer signified his intention to discontinue the use of gas, an agent of the company would visit the premises, take the "state of the meter," and shut off the gas at the meter inlet. Should a new consumer make application for gas supply, and were it found that no meter was in place for the duty, selection would then be made from the list of gas meters outstanding and not in actual service. The company would assume that the meter so selected was "correct" for measuring the volume of gas so supplied.

In case a meter in use would cease to register gas passing through, or if the gas bill rendered a consumer chanced to appeal to the Secretary of the gas company as being rather small as to amount, a "trade" would at once be made, whereby some other meter owned by the company, and out of commission for the time, would be substituted, and thus given an opportunity to show what it could do, in its particular field of usefulness, as arbiter between the gas consumer and the gas company. As I now recall it, about 80 per cent. of the consumers' meters owned by the company were in actual use, the remaining 20 per cent. being scattered over the city in various situations. Memory was trusted to properly locate them when again needed.

There was not, so far as I could learn, a single gas range in regular use in that city. If there were such, the active officers of

the company were not aware of the fact. Neither the gas company nor any of the merchants of the city had gas consuming devices on display, nor did any of the officers of the gas company seem to possess faith in the proposition generally.

The total sale of gas, in the situation that I have in mind, was considerably below 1,000 cubic feet per annum per capita of population of the city. As before stated, the city in question has grown materially, both in wealth and population, during the life of the gas company herein referred to. In due time, however, other capital, owned and controlled by an entirely different set of gentlemen, was invested in a local electric light company, to bid for favor in the lighting field presented by that community. I did not visit the electric light plant, hence cannot testify as to the merit of its peculiar construction, yet it was my pleasure to have met, in a social manner, some of the gentlemen interested in the venture, and in conversation with them, they freely expressed themselves as being pleased with the enterprise in which they were engaged, and gave every assurance that it was an "earner."

A purely superficial examination of, in fact I might say, that a mere passing glance at, the means of illumination common in that city, would readily convince one as to which of the two systems (gas or electricity), was most in favor with local buyers of artificial lighting service.

Upon receipt of word from your committee requesting me to present some thoughts anent this subject herewith attempted by the writer, the case of the gas company herein referred to, which, by its negligence and apparent indifference to the duty it owed to itself, and likewise to the community it was created to serve, instantly came clearly before my mind, and I forthwith decided to make use of the same as a case in point to illustrate a type of very unpopular "gaslight company," that was hopeful of securing public favor and patronage during the closing days of the great nineteenth century.

The further thought came in quick succession, that were any of my hearers (and in particular those who were pessimistically inclined, to whom your committee made reference), attached to any such corporation as the one herein defined, then, indeed, I could not long wonder that some men engaged in the gas industry might readily develop a severe spasm of genuine doubt, and later appear and freely express themselves as true and devoted pessimists.

Such surroundings and practices would surely be sufficient to create something worse than sincere doubt in the mind of any bright, zealous young man desirous of winning laurels for himself as before his friends, because of his achievements; and furthermore, by strict attention to business, earn profits for the direct benefit of his employers, thereby earning for himself words of commendation because of his faithfulness to a duty well performed. What a shock it would be to almost any person, when he, for the first time, was made to thoroughly realize that he was actually committed to pursue such a narrow, restricted and unbusinesslike policy and practice?

It has not been my intent nor desire to outline to you any Utopian plan and policy for the purpose of illustrating any peculiar theory of mine, as to just what would be the most fitting and proper policy for gas companies to pursue generally, neither for any one in particular, for each and every case is so very differently circumstanced, and therefore each and every case would, of necessity, require different treatment or handling, and it therefore follows, that for me to attempt to present any set plan or policy would be sheer vanity on my part, and of no value practically to those who would be kind enough to listen to my expressions of thought.

Communities, as I have obesrved them, express in themselves a species of personality, and oftentimes, quite as emphatically so, as do different individuals. Each is different from the other, and because of this fact our treatment of and manner toward them differs according to our peculiar estimate of the personality expressed in each. Applying this thought to the subject of community life, it is quite apparent that larger cities differ from smaller ones. The college town and the strictly manufacturing town each express in themselves a different type of personality.

The method and general policy to be pursued by gas companies operating in different situations, and all differently circumstanced, must likewise differ according to the personality presented, and the same must be arrived at and determined by those having the enterprise directly in charge.

The human family, generally speaking, are "creatures of habit." The quality of versatility is not commonly distributed; therefore, in many situations, those upon whom the duty devolves to determine the details of a policy to be pursued seem to remain in some fixed state, so to speak. Were they all versatile in their

nature, they, too, would incorporate changes from time to time, and that just in adavnce of the absolute necessity demanding the same.

Managements of gas properties who allow themselves to become adjusted in some "fixed state," as above expressed, and persistently allow themselves to remain so for any considerable period of time, will some day be suddenly aroused from their peaceful state of mind, and the conviction will be forced upon them that because of the inertia that has possessed them for a time, and also because of their failure to be alive and act promptly each day as duty and good business sense would demand of them, that because of this combination of "the sins of omission" rather than "those of actual commission," they will have lost caste in the very community they are forced to rely upon for patronage and support. They will have allowed themselves to drift into the category of the "non-essentials," rather than by proper application and effort to have secured for themselves a sure and sound foothold among the "positive essentials" of the community in which they operate.

There have been many cases of "non-essential" gas companies in (un)successful operation during the past few years, as the large corps of "buyers" in the field bears mute evidence. The methods that obtain with these so-called buyers are quite familiar to each one of us, hence no words of mine are necessary to define the results they achieve. The policy they pursue is such as to yield good returns to the promoters and also to the actual owners of the properties so administered. The changes so wrought are, in most cases, yielding most flattering results, primarily to the owners and operators of the properties in question, and finally to the community they serve with their product, both by improvement in quality of gas, and likewise the character of service they render.

The ready market that is constantly open to would-be sellers of gas properties is a true and ready index of the character of estimate made by practical business men, and likewise men of the "investor" class, when regarding such a problem as "The Future of the Gas Industry" in this country.

Changes in methods and practices are going on constantly, and the necessity for the same is largely due to the constant change in conditions attending. This thought brings to my mind an item that I once before quoted to this body, and as I now recall, it seems to me that I cannot present language of my own arranging

that would so clearly convey the thought referred to, hence will presume to again quote the item:

"Humility is all very nice, but don't practice it to the exclusion of the other virtues. A little self-assertion counts for much. We are rated just a little below our own estimate. If you tell the world that you don't count for much, they will take you at your word, saying that you ought to know. He who is silent is forgotten; he who does not advance, falls back; he who stops is overwhelmed, distanced, crushed; he who ceases to grow greater becomes smaller; he who leaves off, gives up. The stationary condition is the beginning of the end, it is the terrible symptom which precedes death. To live is to achieve a perpetual triumph; it is to assert one's self against destruction. It is to will without ceasing, or rather, to refresh one's will day by day.—Zanesville Meeting, March, 1891.

DISCUSSION.

PRESIDENT WHYSALL:—We have a very interesting paper now before us for discussion. I see Mr. Butterworth coming into the hall, perhaps he can lead the discussion.

MR. BUTTERWORTH:—I find myself somewhat in the condition of the old maid who was asked by her sweetheart, after a protracted courtship, whether she would be his wife, and she said: "Oh, this is so sudden." I do not know what to say, except this, that I think there is no ground for pessimistic views in connection with the outlook of the gas business in this country, and for two reasons. One is because it is cheaper than electricity, and the other is because it presents such a large field for fuel business. I think there are the two chief grounds upon which we can base our hopefulness for the future of our profession. We can look about us and see in almost every community probably two-thirds or three-fourths of the lighting done with oil, even yet, because it is supposed to be a trifle cheaper than gas. Now, if gas were even only a trifle cheaper than electricity—saying nothing of being nearly one-half cheaper—you can see what a future there is for the artificial gas people in the realm of lighting. So far as its usefulness for heating is concerned, there is nothing to compare with it for cooking.

GENERAL HARBISON:—Mr. Faben presents, in that very interesting communication to the Association, thoughts of much value, and the experience and observation to which he alludes are known

to nearly all of the older gas men, partly from having come under their own observation and experience, and partly from the observation and experience of their neighbors, where they might not be willing to admit that they have been following somewhat in the same lines, but be willing to turn it over as against their neighbor's acount. There is not any question, Mr. President, that much of the success—indeed *the* success of any company—results from the efforts of the manager. He should be in close contact with his constituency. He should know them personally, as far as possible, if they are not too great in numbers. As far as possible he should know them, and their wants and their condition. He should know their requirements and the remedies before they suggest themselves to those whom he serves. He should keep in advance always. He should keep his work up in all its details. He should not neglect meter complaints; should see that all meters are in up-to-date condition, and get in that way the very best results. The sucessful gas manager should know the existing conditions in his own city. In our little burg, Mr. President, we know at the close of each year, and as often as we choose to figure it out, the whole number of gas appliances which our company has sold since we entered into the business of selling. We know how much has been sold each year, and we can tell from our own records what any man or woman has purchased for a long term of years; what the first article was, and what they paid for it, and we know as to the efficiency of the service from a complaint record kept for the purpose of giving us just such information. We do not know how many of such articles have been sold by dealers throughout the city. We do not object to all the dealers in the city in that line handling them. The more they sell, the better we like it. They will burn just as much gas as those we have sold. I do not, however, believe in the suggestions which are made that the gas company should put in services free, and should furnish stoves free, and should furnish burners free. Sell them gas at a good living rate: furnish a good article, and let the consumer pay for what he has, just as he does for the painting of his house, the repapering of his walls and the furniture he decorates his house with. So soon as you begin to contribute in the way which has been suggested, and which some are practicing by giving away these articles, just so soon you are lowering yourself in the respect and esteem which they should have for you, in the manner in which you conduct your business. It is not necessary to give these

chromos to induce people to burn gas. The only thing our company has given away in its 51 or more years of experience, has been good advice. That we have given a lot of. That has given us good returns, and has not cost us much. Atmosphere and natural gas, such as some of us furnish free of charge, is not very expensive, and there is a great abundance of it. It is appreciated by those to whom you talk, if you talk earnestly to them. Educate the people to believe the statements you make, and you will have no difficulty. You must learn, however, to back your statements up day by day and year by year. Do not make any statement that you cannot verify in a straightforward and frank manner a week hence, a year hence, or 10 years hence. Carry on your business on these lines and you are beyond unreasonable criticism. You are not afraid of any kind of criticism that can be brought against you in the conduct of your business. The gas business, conducted on such lines, will surely make your company a successful one. Get away from the little notions we had a third of a century ago. It will not do at all in this age of progress. Mr. Faben alludes to this same thought in his paper. I remember the time when I thought all that was necessary to do was to have a sufficient supply of gas in the holders to carry us safely through the night. We older members of the profession remember the changes which were wrought by kerosene oil when it first came into the market. In our little city the business went down in four or five years from an output of 105,000,000 to 65,000,000 by the introduction of kerosene oil, and the selling price for gas at the same time went from $3 per 1,000 to $2 per 1,000. We were trying to stop the introduction of kerosene oil and bring back into the gas field the meters which were not used. We took out more than 1,200 where they stopped using gas and commenced using kerosene oil. We struck a $2 basis, and the first year we put out 65 more new meters on the $2 gas than we had the year previous. There has been no year since that we have not increased that number, and during the past year more than a 1,000 new meters were added to our total number, and our sales amounted to 26,000,000 cubic feet more than in the year 1893. That was at the rate of $1 per 1,000, with $1.25 at the beginning of 1898. We are still regularly operating on that. We are trying to introduce incandescent burners, but we are not giving them away. We are selling them at just enough to pay the expense of the handling. We are adjusting them for people, and we are guaranteeing the life and efficiency of the

mantle at an agreed upon rate per year. It is an entirely satisfactory arrangement to both parties. We will not get rich in guaranteeing the life and efficiency of the mantle at 50 cents a year for each incandescent burner they have in the house or store, but it will pay the cost and expense—that is all we care for—and give great satisfaction to the customer. These thoughts come at random, Mr. President, in response to your call, on the subject matter now before you.

The Chair then called upon Mr. McIlhenny, who said: Mr. President, I do not know that I have anything especial to say, except that the paper is a very interesting one, and one, I think, apt to be read over and over again. It shows in a very attractive way the contrast between the conditions of the gas business in the past and the conditions that prevail now, and also the outlook for the gas business in the future. As to its future prospects it seems to me that there is certainly no cause for pessimistic views in the cities throughout the country. From all directions we hear that the gas business is growing apace, notwithstanding the increased use of electricity and the various forms of lighting. And I believe that it will continue to increase. There is one comforting thought which, I think, we can lay hold of, and that is, that there has never been any substantial commodity used by the people which can be driven out of use. When candles were used so generally, the candle mongers made complaint when lamps were first introduced, and a gentleman who was in London several weeks last summer, told me that he saw in the British Museum a copy of an address issued about 200 years ago by the Candle Mongers Association of London, to Parliament, protesting against the manufacture of "lanthorns," as they were called, or lanterns, stating that they were at great expense and trouble to educate their apprentices and establish their business, and it looked like the introduction of these "lanthorns," by which a man was enabled to hang a light outside of his door at night and thus throw light in front of his place, would drive out of use, candles for illumination, using tallow or other oils inside the lamp. But to-day there are more candles made and sold and used than ever before in the history of the world, notwithstanding the fact that since candles had their day, oil has come, gas has come, and electricity has come. I think that there is nothing which has been generally used by the people that has been entirely dispensed with. Extra demands and needs of the people, as civilization advances, take care and absorb all of

the old articles as well as have a great capacity for the new. I think this is comforting thought, that no matter what may come, we may realize that gas still has its field for usefulness. The cost of manufacture is being reduced, new fields of usefulness are being opened up, and I for one have every confidence, and I am full of hope for the future success of the gas business.

F. W. STONE:—I hardly know whether I am pessimistic or otherwise. I feel this way about it. I believe a pessimistic man is one of those who would use all of the inducements which have been set forth in the paper to advance the sale of his gas. That is, the giving away of appliances, putting in of free services and the keeping up of the Welsbach lights for nothing, the putting in of Welsbach lights and everything of that kind. I think if a man had faith in the merits of the thing he was selling he would not find it necessary to do that. That they would get along without it. If you educate people into expecting things, you will find that they want them. If you let them alone, usually they do not desire them. If you educate people into the belief that gas is the thing for them to use, that it has merits and advantages, then they will buy gas, and they will buy the necessary appliances to use it, so that it will not be necessary for you to give such appliances away in order to help the business along. Some time ago there was an organization of a ladies' literary society in our town, and they had a little social one afternoon, and they had a lot of sandwiches left over. One of the ladies suggested that it would be a nice thing to give the sandwiches to one of the little boys who belonged to her Sunday-school class. The basket was taken down and given to the boy. The next week she met the boy and said to him: "Johnny, how did you like the sandwiches?" He said: "We liked them first rate, ma'am; and papa told me to ask you if you didn't have a pair of pants you could give us, too." That is just about the way of it. If you give the people something free at one time, they want something else after a while. They crowd their demands for something else on you, and pretty soon you will find that there is no end to the demand and you will be doing business without any profit in it. I do not believe in giving away everything in order to secure business. It seems to me that there is a fever abroad in the gas business at the present time among some companies, who seem to want to get business at most any price. It does not make any difference to them what they have to give away or what they have to lose, just so long as they get

the business: they want the volume regardless of the cost. Now, I look at it this way: that whatever you put out for nothing is just a species of advertising, and when you pay out money for advertising you not only expect to get back interest on your money, but you expect to get back the money itself. Advertising does not pay, unless you get back the interest on your money and the money you invest in it. When you put out fuel appliances, or when you give things away and induce people thereby to use gas, you have to charge it up on one of two accounts, either to capital account or to expense. If you charge it up to your expense account, it cuts down your profits. If you charge it up to the capital account, after a while you will find that you have a capital account that is loaded down. You will find that you have a big capitalization with nothing to show for it, or a big construction account, with nothing to show for it. For instance, you set a range for Mrs. Brown to-day, and the cost for setting that range is $3 for labor and $2 for pipe. Mrs. Brown in a short time moves out of the house, and Mrs. Jones comes in, and she wants her range on the other side of the room. She does not like the location where Mrs. Brown had it at all, and you have to send a man there to change the piping and reset the range, and you have another $3 added to your investment. It is my experience that it is not necessary to give things away, if you advertise the merits of the gas business. If you advertise the advantages of it, the convenience of it, you will not have to give appliances away in order to increase the demand for gas. I believe in giving good service and keeping down the price. You cannot cut down the price of gas so far as the selling price is concerned and at the same time give chromos, free service, free burners and everything else away. They all figure in the cost of operation. You have to get out even and therefore are not able to sell gas as cheaply as you otherwise would be. Hence, I say, cut down the price of gas to the lowest possible selling price, give good service, close attention to the business, hustle for new business, go and see your customers frequently, advance the business, and advertise it in every way you can. That is the way to succeed rather than by giving things away. Mr. President, I just wish to say in justification of myself that in my own experience in the last four years, we have increased our output from 5,000,000 to 20,000,000 feet and we are not doing any free business at all. We have not found it necessary. I think we have between 70 and 80 per cent. of the people

located along the lines of our mains who are using gas to-day. We have secured this large percentage simply through solicitation, going to see them and presenting to them the merits of the gas we sell.

President Whysall:—It might be interesting in that connection, Mr. Stone, to state to the members of the Association the increase in the population during that same period.

Mr. Stone:—Mr. President, the increase in population has been from 10,000 to 13,000 in the last 10 years. While we have a population of 13,000 yet we only have an available population of 10,000 so far as the gas company is concerned. There are 3,000 people across the river where it is almost impossible to reach them. They are a mile and a half or two miles away from the location of our works, with a stream 21 or 22 feet in depth between and a line of ore docks. It is not impossible to get across, but we do not think the business on the other side would justify it just at present.

Mr. Andrews:—In this matter it seems to me that the policy we should adopt is one which is a mean between the two which have been spoken of. I do not believe in giving stoves or utilities of that kind away, but I believe in selling them at the lowest possible figure. When it comes to putting in service pipes and connections, I have always made a practice of charging to labor, the expense of making the connections, and only charging the actual material used to capital account. That obviates the difficulty spoken of by Mr. Stone of increasing the capital account out of all proportion, or on the other hand making your expense account too heavy. That pipe remains there. It is used for the purpose of increasing the output of your works. On the other hand, if you charge all the expenses to the consumer the result is that while you may get some business, it comes more slowly. People will consider quite a number of things before they go to the expense of putting in service pipes. Take, for example, a service which costs $10. Average results show you that you ought to get in the neighborhood of at least $1.50 per month from that service, or from $18 to $20 per year. You can afford to pay for the cost of that service out of your earnings, but the plan I spoke of enables you to get fair interest on the investment and to retire it within the life of the service.

Mr. Malone:—We have had considerable experience in reference to the placing of gas stoves. We have placed about

1,500 ranges in the last four years, starting late in 1896 with about 200, and now we have about 1,750. We have charged for everything. We get an average of about $9 for services and we sell our stoves a little in advance of actual cost. We made a personal canvass from house to house. We have data on our records of every house in town. We have increased our sale of gas from 18,000,000 to 52,000,000 in about two years and a half. The increase in population in the last 10 years was from 13,000 to 19,000, but the greater part of that was in the last five years. There is one thing which I think adds as much as anything else to the success of a gas company, and that is the giving of strict attention to complaint work. There are a lot of people who imagine their bills are to high, and we always volunteer to have some professor come down from the university and test the meter. If the meter is found to register wrong, we are willing to rebate for six months the amount of increase over what it should have been when tested. We find we get good returns for our efforts by educating people up to feel that they are getting value received for whatever they pay. Last month we had but three complaints on account of big bills. Some of them had bigger bills than they had the corresponding month the previous year and entered complaint, to which complaints we were always very careful to give immediate attention. The fuel sales average about 60 per cent. of our gas output. The electric light plant is also run by the same corporation, but we have never endeavored to push illuminating gas. We have never pushed either one, so that two-thirds of our output is fuel gas.

Mr. Butterworth:—Mr. Malone stated that they had never pushed either one. I think he means that they have never pushed one as against the other, but that they have endeavored to push both.

Mr. Malone:—That is what I intended to say, that we have never pushed one as against the other, but have done our best to advance the interests of both.

President Whysall:—Mr. Butterworth, you probably have some information as to what was done in Milwaukee by Mr. Cowdery.

Mr. Butterworth:—All that I can say on that subject, Mr. President, is that Milwaukee is recognized as the banner town of America for the sale of gas, all things considered. They sell more gas per capita in that city than any other city in the United States

similarly situated. The average, I believe, is 3,500 feet per capita per year. They do it by having a sliding scale for gas used for fuel purposes, and another sliding scale for gas used for illuminating purposes, based on the quantity used in each case. And they try to meet all demands in that way. They do a large business. I was just thinking, however, that this discussion has taken a turn rather different from that suggested by the paper; in other words, I think we are getting a little off the text. The paper calls, I think, for an expression of opinion from us as to whether we need to be discouraged about the future of the gas business. It does not call for tests as to how we manage the business, although I take it that what we can gather from the tone of this discussion is that by using these methods, and by cultivating our business in the way that has been suggested, there is no need of despair, but on the other hand there is every reason for confidence. I think that is the view we all have of this matter. I would like to have a rather more emphatic indorsement of the idea that there is no occasion for pessimism as regards the gas business.

MR. PERSONS:—There is one paragraph in the paper to which I wish to allude. I think Toledo was the first city in the United States which offered free installation and maintenance. They have adopted a form of contract and offered to give a business house, using a certain number of lights, free installation and maintenance of incandescent light. If a store, for instance, is not properly arranged to light to the best advantage, they are putting in what are called H. & M. fixtures, with incandescent lights, and maintaining them free of expense. That seems to be the policy of the company, and the best way to meet an emergency which confronts it. Of course people who have natural gas to contend with are required to conduct the business differently, as compared with the company which does not have this competition to meet. If the company simply has oil as a competitor, it may be inadvisable to do these things. I think, however, some of the people here present, for instance, Mr. Printz, who has to meet natural gas competition, could give some testimony that would back up the policy of the Toledo Gas Light and Coke Company. Of course, the capitalization and things of that kind have a great deal to do with the whole affair. Yet it is simply a matter of policy. It is just like the tariff. I do not think anybody can lay down a rigid rule by which to sell gas outside of their own town.

George D. Roper:—I will say, Mr. President, that I do not feel afraid to get up in an Ohio meeting, because this is the only place where a supply man is supposed to have any brains. I would like to say that if there is anybody who has any doubt as to the future of the gas business, and they will take Brown's Directory for the last ten years, he can soon convince himself that it has an assured future. By an inspection of that directory, you will see that if a man were selling 1,000,000 feet of gas per 1,000 inhabitants he was considered a hustler, but now the company who is not selling more than 1,000,000 feet of gas per 1,000 inhabitants, is not considered in the business at all. He has stood still, as Mr. Faben says. The conclusion is that if you have any doubt on that point, just study up the subject yourself by a reference to Brown's Directory. I had the pleasure, yesterday, of being at Aurora, Ill., where I saw Mr. Copley, who has a plant in process of building at La Grange, Ill. He does not expect to turn the gas on for six weeks or two months. He has 231 houses piped, and over a car load of stoves already sold. If anybody has any doubt as to the future of the gas industry, they should simply take a few of these facts home with them and study them.

John R. Lynn:—Just one thing more comes to my mind by a remark which has been made during this discussion in regard to charging these various donations to different accounts. It strikes me very forcibly that there is really more good, every-day, sound horse sense in selling, say, 3,000,000 cubic feet of gas at a profit of 30 cents per 1,000, than there would be selling 2,000,000 at a profit of 40 cents. If you are compelled to spend a little money to get that additional consumption, you are certainly well paid in the additional profit that you have received in the aggregate.

Mr. Printz:—As Mr. Persons has said, we have competition with natural gas, and as a consequence we have to do a great many things which we would not otherwise do. In our case, we were selling gas at $1, and after natural gas came in we found that even with gas at that price we were losing our consumers. In order to hold them, we loaned the burners and maintained them. We do that, not only for business houses, but for private houses, limiting the number of burners in a private house to one burner for each $3 worth of gas used per year. That makes it so that the average number in a house will be from three to four burners. We find that it costs us for that maintainance about 15 cents per 1,000 feet of gas sold. As yet we have found it wise to do it.

While we have not held all our customers, we have held many that we would not have otherwise held. In our case, we have furnished not only the burners, but have furnished the fixtures. However, they are all loaned so if the service should leave us at any time, we can get our burners and fixtures back again. Now, some of the members have spoken about putting in the service free and furnishing some other appliances. For a number of years I endeavored to sell stoves. We found that they went very slowly where they were charged the full price for the stove and charged for the setting. We afterwards made arrangements by which we would sell stoves at cost and set them free of charge, and from that time on we had no trouble at all in placing the stoves, and we did a good business in our little town of 23,000 or 24,000 people. We were selling about 53,000,000 feet of gas a year, and I can say to-day, even with natural gas in competition with us, we do sell some few stoves. I think it is to our advantage to sell the stoves at cost, and set them free of charge.

MR. McILHENNY:—I move that a vote of thanks be tendered Mr. Faben for his paper and for the very general discussion which has followed its presentation. At the same time I move that we extend to Mr. Faben our great sympathy on account of his sickness and his inablity to attend this meeting, and trust that he will shortly be restored to his usual good health.

The motion, being duly seconded, was carried.

THE PRESIDENT:—The next on the program is the

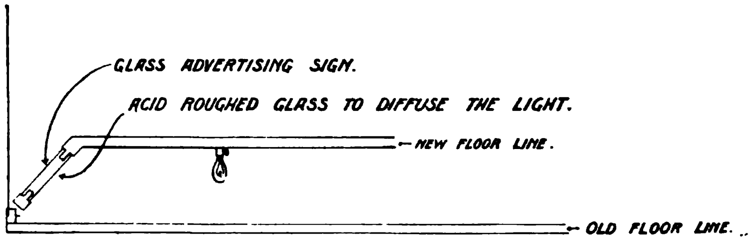
NOVELTY ADVERTISING DEPARTMENT.

B. W. PERKINS, EDITOR.

The following have been received in response to requests for advertising novelties:

H. L. DOHERTY says: "At Madison, Wis., we have a cement walk in front of our office, and in this walk we have set in letters of blue cement, various advertising matter. We also put electric sign lamps in certain show windows in town, worded 'Buy gas stoves,' and 'Use gas for fuel;' at the head of every news column in Madison, we keep the one-line advertisement the year around, 'Cook with gas.' We were thinking of mounting a gas stove on a wagon, supplied with gas from cylinders under pressure. I expect to insert a heavy piece of sidewalk glass in the middle of

the sidewalk with an advertisement painted on the under side of it, and have electric lights beneath it to attract people's attention after dark. As sweating and washing windows soon destroys gold lettering, I am now using gold lettered signs on a strip of plate glass, hung inside of the window, and an inch or more away. A sign of this sort never sweats, and can be taken down when the window is washed, and seldom needs washing itself, but when it does, it can be washed more carefully than the washing of the window is apt to be done. In Denver, we are planning to raise



the floor of our exhibition windows about 10 inches above the bottom of the plate glass. The floor will extend to within a few inches of the plate glass, and from the front edge of this floor to the bottom of the plate glass, will be a sash inclined at an angle of about 25 degrees from vertical. The glass in this sign will bear some suitable advertisement, and directly back of the pane on which the lettering will appear, will be acid roughed glass, and the whole will be illuminated with electric lamps under the floor of the window. We have just ordered a repeating phonograph, which we intend to run every day during the payment of gas bills on the inside of our office, and on other days will be suspended over the door of our office so the sound will get out on the street. This phonograph will be run with an electric motor, and will deliver a lecture on the merits of gas stoves. It will repeat the same thing over and over all day long. I have also borrowed some woman's kitchen, which had a gas stove, and sent a demonstrator there to give an exhibition to the women of the neighborhood that our solicitors could induce to attend. I expect also to use attractive photographs on glass for advertising signs."

J. H. Maxon, Gallipolis, O., has found the following effective: "A lady has been here recently demonstrating the merits of mince-meat. We furnished her with a gas stove to do the baking with:

she worked in five groceries in different parts of the town, and we moved the stove from place to place, furnishing everything free; the ladies who looked at the pies, etc., always noticed the stove and how well it baked. We have sold several and have prospects of quite a number more just on the strength of this ad."

Mt. Vernon, O., says: "Get every cook in your town to demand 50 cents a week more for her services in those houses where gas is not used for cooking." This suggests the idea that the cook would be a valuable ally, and that judicious advertising matter placed in their hands would not be amiss.

Donald McDonald, Louisville, Ky.: "Encourage the consumers to complain whenever there is anything about the stove to complain of; see that it is remedied, and, if possible, see that the cook knows how to prevent the same thing happening again. A man will put up with a cooking stove that is unsatisfactory for a long time, but he will not pursuade his neighbors to buy one, and if his cook changes homes, she will not insist on her new mistress getting one."

F. R. Persons, Toledo, O.: "We are doing a free installation and maintenance business, and putting up about 100 incandescent lights per day. We find the cost of maintenance is about 3 to 5 cents per month per light."

Mr. Hayward, New York: "There are only 1,000 gas-works in the country that we wish to reach, consequently we have found articles such as desk fittings, paper weights, erasers, rulers, paper cutters, etc., have been appreciated and kept, and become, to a certain extent, permanent advertisements. We believe, in the small class we desire to reach, that it is quite successful in the way of advertising. We are not so sure when it comes to general work and reaching large numbers. It would be too expensive; although if I were manager in a town or city for a gas company, I would certainly use some of these things."

Joseph Light, Dayton, Ohio., keeps an ad. in the papers, asking consumers to send word to the company if their lights are at all unsatisfactory.

F. W. Stone, Ashtabula, O., uses the back of his gas bills, on which are printed various ads. calling attention to coke and gas for different purposes, etc. Attention is called to the ad. on the back by a notice on the face of the bill.

George P. Knapp, Augusta, Ga.: "I sell a man a gas stove, then tell him I will pay him $1 if he will sell his neighbor a stove, and so on, adopting the chain system, so it makes everybody my agent, and everybody 'yellin' for gas ranges. We have a hard people to get, but I am getting them to the tune of a couple of hundred a season."

The Rockford Gas Company, Rockford, Ill., sold sad-iron heaters at 25 cents and offered to buy them back at 30 cents from all who were not satisfied with them. None were ever returned.

H. W. Douglass, Ann Arbor, Mich.: "Believing that few of our customers understood the advantages of the planked fish, and appreciating the fact that this could only be done on a gas stove, we had made a number of fish planks and sent them with a recipe and our compliments to a large number of our best customers. I think this met with fair success."

G. A. Allen, Zanesville, O., uses a blank form for yearly consumption of each consumer, the consumption of each month, the total for the year, and the average monthly consumption are all put upon it; at the top of the sheet is a short circular mentioning the advantages of gas for light and fuel. He says: "It has proved the best regular thing we have struck. We get them out as soon after January 1 as possible, just when gas bills are the largest, and mail one to each consumer. The average man remembers only his December bill, and the statement brings to his notice directly the monthly average. The first year we sent out these annual statements we received many letters in reply expressing surprise that the writer's gas bills were so small."

F. H. Shelton, Philadelphia, Pa.: "We have offered prizes at times for the best treatise on 'cooking with gas,' say a free stove once a month for the best composition received during the month. We are great believers in lending stoves for church socials, as a matter of educating an excellent clientage."

R. M. Searle, Mt. Vernon, N. Y., increased the sale of coke by the following novel method: A lump of coke was neatly wrapped up, tied with pink ribbon, and sent to possible customers, with a card reading as follows: "Thousands use gas coke for grate and furnace fires. Cleanest and best fuel. Remove this silk

ribbon and note how clean it remains, after being tied to this sample of gas coke. Tie it to a piece of soft coal, then remove it immediately, and note the condition of your hands and the ribbon. 'Nuff sed!'—Atlanta Gas Light Company." He advertised coke under the catch-word of sootless fuel; the combination of pink ribbon and lump of coke was so unusual as to attract a good deal of attention.

H. L. Olds, Lincoln, Ill., says: "We will trade a gas range for almost anything in the house, in fact do anything to get a gas range in use, but we will not give them away, nor sell them for less than cost."

Charles H. Printz, Little Rock, Ark., finds a circular as below both novel and effective:

"LOSS $616,535.

"Chief John League reports that during the year 1899 the fire losses in Little Rock reached the enormous total of $616,535, among the causes of which were the following:

Burning chimneys	29
Gasoline	4
Defective flues	17
Lamp explosion	8
Defective hearth	5
Sparks on roof	14
Electric wires	11
Gas	0

"A word to the wise is sufficient."

C. T. Mason, of Chicago, sends the following novel coke advertisement, seen in the Fostoria Gas Company's office: "A glass box about 12 in. square and 18 in. deep is filled with coke, and lighted by means of a red electric light placed in the center. Over this box is an appropriate coke sign." He also describes another novelty that, while not particularly an advertiser, is nevertheless worth mentioning. A book called the complaint book is placed on a convenient desk, with pencil, etc., and by means of a sign near by, the consumer is requested to make his complaint thereon, and leave orders for new tips, etc.

THE WAUKEGAN, ILL., GAS COMPANY gives away tin match boxes, with appropriate lettering, which calls attention to the fact that a match is all the kindling required for a gas range.

THE GRAND RAPIDS GAS COMPANY uses a pad calendar; in the memorandum lines of the first 17 days of every month are very cleverly worded reminders of discounts, price of gas, entrance of employes to consumers' premises, etc.

IN SOUTH BEND, our novelties consist of a large kite, to the string of which is attached a 30-foot banner properly lettered. The kite is flown in different parts of the town, and always attracts attention. We put ranges in windows of drug stores, or any store where they will attract attention. The greater the difference between the goods sold by the store and stoves displayed, the better the ad. We have given away puzzles and Mother Goose books to the children, and lettered fans, which were distributed at summer gatherings, and which people kept. Large fence and blank wall signs have been used with success. During the warm weather we always like to have a stove in our wagon, whether it is to be put up or not. We are considering the use of a stereopticon on the public streets evenings, using interesting pictures in which will be sandwiched gas stove and light ads. and views of kitchens equipped with gas ranges. In short, we adopt any successful advertising to the gas business. Numerous novelties could be used by the gas business—cheap caps, such as clothiers give away, tin cups, with ad. printed in the bottom, photograph buttons, printing gas ads. on grocers' paper bags; the last two have been used by some gas companies. Some of the printed matter given the public could be printed on calico, etc.

I regret very much that the list of novelties is not greater, and hope that the few facts I have been able to bring to your notice will serve as means of bringing out others.

DISCUSSION.

MR. BUTTERWORTH:—I simply want to say, Mr. President, that I think this is one of the most practical and useful departments that has come to my notice for some years. I am proud of the Ohio Association for having gotten up this "Novelty Advertising Department." I think we can get many very, very valuable hints from it. The scheme employed by Mr. Searle, of Mt. Vernon, N.

Y., of wrapping up a lump of coke tied with a pink ribbon, reminds me of one employed by Mr. Finn, of Boston, where he sells the coke of the New England Gas and Coke Company around the town through the retail grocers. It is sacked up in paper bags and marked "Smokeless Fuel." Customers buy it at a fancy price, and are very glad to get it. It is ordinary coke marked "Smokeless Fuel."

General Harbison:—I am very glad to know that something is being done in the advertising line. I have experimented a little in that direction myself, and one of the first means I adopted was to have a good front window to my office and there have a display of the various kinds of stoves, ranges and apparatus generally, lighting them six evenings in the week until 10 o'clock. The light attracted attention, and people would come and look at the display. I tried newspaper advertising and street car advertising with a variety of cards, changed once a week in each car. I was not satisfied with the rsults, though they were good. A few years ago, I learned of a man who had been employed in making a house-to-house canvass throughout the city of Syracuse with wonderfully gratifying results. I secured the services of that man. After having used him two years successfully, I thought that was all that was necessary to do for the time being. I set him at work, and he made a house-to-house canvass with a certificate of the gas company with him to show that he was authorized to represent them and that there need not be any question in the minds of those he called upon as to the truth of his statements when he said that he came from the gas company's office. At every house he visited, he made a memorandum as to whether they had any stove for cooking or heating, any kind of gas fires, how they were serving them, whether they were thinking of getting one, and so on, and he made his report to the Secretary every day. That report was kept on file. That was in 1899. In 1900, he started in anew and covered the same territory with such additional streets as we had laid pipes in where there had been none before, and had with him this memorandum of the visit of the previous year. We have covered the city in that way very thoroughly and with very satisfactory results. I do not think it necessary to continue it now for a period of two or three years, perhaps, because we have so very thoroughly covered the ground in our previous efforts and in this special work in the last two years, which we found to be very satisfactory and successful.

MR. BUTTERWORTH:—I want to say a word in behalf of Mr. Doherty's advertising scheme. It contemplated the co-operation of the gas companies of the country entering into an arrangement for the purpose of advertising gas for cooking purposes in the leading magazines and periodicals of the country—for instance, Century, Harper's, Munsey's, Ladies' Home Journal, McClure's, inserting a page ad. in one of them each month, going into the merits of cooking with gas, the payments to be made by contributions from the gas companies of the country. That was one of the matters he had in view. He presented it in an immature form at the last meeting of this Association, at which General Hickenlooper was present. The General, I am sure, through a misapprehension of the purposes and objects of Mr. Doherty's plan, threw cold water upon it, and Mr. Doherty withdrew his motion for the establishment of such a bureau for the time being. I hope something can be done further at this meeting to carry out the enterprise.

MR. MCILHENNY:—I move a vote of thanks be tendered to B. W. Perkins for the very able manner in which he has handled this subject, and which will prove of such assistance to the Ohio Association. (Seconded: carried.)

QUESTION BOX.

THE PRESIDENT:—Question 2—"How much can a company afford to pay to get a gas range installed?"

MR. CHOLLAR:—I would suggest that they can afford to pay enough to get it installed.

JAMES T. LYNN:—That is about what I was going to say. Local conditions have a great deal to do with it. A company selling gas at $1 per 1,000 probably could not afford to pay as much as if it were receiving $1.15 or $1.20 for the fuel. I think it can pay just enough to get the range installed.

MR. PRINTZ:—I would say in answer to that question that it costs us on an average $10 to install a stove for the number we install during the different seasons.

GENERAL HARBISON:—Do you think it is profitable?

MR. PRINTZ:—Yes, sir.

MR. CLAPP:—Mr. President, that is a great question with our company. I had almost come to the conclusion that I would give away ranges, but since I have heard the discussion to-day I am in

doubt about it. I would like to have more information. Now, I understand there are companies in this state, and throughout the country, that have given stoves away entirely to the consumer to induce him to use gas. If that is the case I would like to hear from them.

MR. PERSONS:—In Buffalo, where natural gas competition has been very fierce, they have set a great many ranges at a cost of something over $20; those ranges are all in the cheaper class of houses, and are not in use over three or four months in the year. Then they are taken back to the warehouse of the company, cleaned up and put in condition for another season's work. That entire expense is something over $20. I do not know the exact figures, but they consider it profitable. Suppose it costs $30 to install a stove, I would like to have some information whether it is profitable or not at that price, and why it is not considered profitable to expend $30 to install a stove. Thirteen dollars for the stove, with the meter connections and everything, comes pretty close to $30. I would like to hear from some one whether or not it is profitable at that price.

MR. ROPER:—Probably the largest deal that has ever been made was made this year in the City of Baltimore. Mr. Moses has contracted to place 10,000 ranges in Baltimore inside of one year. The average amount the company pays him is $10 a piece, he taking and piping the range from the meter, installing it ready for use at an expense to the gas company of $10 each. These probably are the best figures that have been made or that anybody knows of. They made this contract with Mr. Moses for the simple reason that the Trenton Gas Company the first year gave away ranges, and—I quote from memory—I think, 1,200 ranges were put out the first year in a city with a population of 75,000. The next year they put out, I think, 120; last year they started in, but, as the manager said, it was a conservative town, and it was no use, they could not put in any stoves, and they gave it up. Mr. Moses finally induced them to let him take hold of it, I think in the month of June, after the average man thinks that his stove trade is over, and in three months he put in 2,600 ranges in a town that was conservative and had been worked to the extent that it was thought nobody could sell any more ranges. They were unsuccessful in giving them away, unsuccessful in placing them in any way, but Mr. Moses took hold of it and placed 2,600 in three months. On that record, and from data he had obtained, he took hold of

Baltimore, and up to Saturday night had sold over 1,000 ranges. I happened to be at the New England meeting when they read a paper on how to sell gas, and the President, after the paper was read, said that he believed newspaper advertisements were very good, and yet the advertising was done at the season of the year when it should not be done. Then he turned around and said: "I would like to call on the gentleman from Trenton." Mr. Moses got up and said that he did not believe that there was any season of the year, so far as the gas business was concerned. He said that he was now advertising full page ads. in Baltimore papers, in the Camden papers and the Trenton, N. J., papers, all of which towns he was handling. He was selling in Camden at the time, I think he stated, some 30 odd stoves a day, and proportionately in the other places. So I say it is not the season, but it is the man and the way he gets at it.

John R. Lynn:—I think this question can probably be almost answered in answering question 1 of the question box. I think if that first question was answered, each of us could figure out this problem to suit his own particular condition.

H. L. Olds:—Mr. President, I am a little like Mr. Chollar. I think a company could afford to pay whatever it costs to set the range. If the expense would be $10, I would say that is what the company could afford to pay to get the range installed. I think the range should be put in regardless of cost.

The President:—We will try Mr. Lynn's suggestion and submit the first question for answer: "What is the average consumption of a gas range?" What is it in Toledo, Mr. Persons?

Mr. Persons:—I really do not know. With gas at 95 cents the average bill is somewhere about $30 a year.

Mr. Clapp:—In Middletown, at first, bills of consumers using gas exclusively for cooking averaged about $2.50 per month. Since that I think the gas stoves are much more economical. Now I think that the average would be about $2 per month. Whether it is profitable to give away gas stoves in order to get consumers is a question I would like to hear about from the various members. It seems to me that is what we were trying to get at when this other question was sprung. I would like to know if it is the sense of this meeting that it is profitable to give away gas stoves in order to get consumers?

James T. Lynn:—I think it is a question which will vary according to the price at which gas is sold. I know in Sheboygan,

Wis., the average is very low for stoves, only about 14,000 feet per annum. In Port Huron the average is about 28,000. In Sheboygan gas is sold at $1.30 for cooking, while in Port Huron we sell it at 80 cents; consequently the cost of manufacture and distribution is in accordance with the price. I may say that the average profit on 1,000 feet of gas would be about 80 cents, selling it at, say, $1.30, and as a stove consumes 14,000 feet a year, you can figure out how much you can afford to pay to install a gas stove. I do not think you should expect the first year to get back the cost of everything, but if you are making a good, fair interest on the money invested, I think everybody is willing to spend the money in putting in gas stoves. If the profit is 50 cents per 1,000 on the gas and the stoves average $20 per year, he is making $10 on each stove every year, and he can soon figure out what it will pay him to put in gas stoves.

John R. Lynn:—If he install a stove free, which costs him $15, he would have then an investment of about $8, and figuring as high as 8 per cent., he is paying $2.40 a year.

Mr. Olds:—We took off a list of 100 consumers for the month of June; the average bill was $2.13, and the average bill for the month of May for the same consumers was $1.88, with gas at $1.25 net. I think that a company could afford to pay whatever it costs in installing gas stoves; if it costs $10, then it can afford to pay $10 for the installation.

Mr. Roper:—Some years ago, this question came up, and I secured data from five different towns, three of them where they had two meters, so that they knew what the stove consumption was, and two of them where they did not have separate meters. In one case, with a 16-inch oven, the average was not quite 2,000 feet per month; in the same case, with an 18-inch oven, the average was about 2,400 feet per month, while in the towns where there was but one meter and where they had estimated what the light would be, it ran a little higher than that. Now, that may have been figured by deducting light for the previous year. That does not go to prove that an 18-inch oven uses more gas than a 16-inch oven. Whenever a gas-stove man gets up and talks about how much it costs to install a range, he talks about it costing $15, but when he goes to sell a range, it will be $9.

Mr. Lynn:—I would like to ask whether that average was for the year or just during the summer.

Mr. Roper:—For the year.

MR. CLAPP:—I had reference to the summer months. We have not come to that point yet where we can get gas stoves used the entire year, but simply during the summer months. I think in the larger towns and cities, the average is much lower, especially where we have a manufacturing town.

MR. LYNN:—I think the gentleman is mistaken with reference to the large and small towns. I think the average of the consumption of the gas stoves in a large town is greater than in a small town, for the simple reason that we have a great many more houses heated with furnaces and other appliances, and in smaller towns you do not find so many furnaces. You do not find so many appliances, radiators and registers for heating the kitchen in the smaller towns as you do in the large towns, and consequently they use their gas stoves in the winter months, while in the smaller places, where they depend solely on the cook stove to heat the kitchen, they do not use the gas stove in winter.

MR. CLAPP:—I had reference to the summer months.

MR. ROPER:—I do not wish to take up too much time talking, but I would like to say this, that gas companies and gas managers are themselves responsible for gas being sold as fuel during the summer only, for the simple reason that in nine out of every ten advertisements that you read, you find that the gas company commences along in the spring, advertising gas as a summer fuel and gas for summer cooking. They will insist upon putting the word "summer" in their advertisements. I had an experience about three years ago, when Wanamaker took hold of Philadelphia. I happened to be there when he wrote up the first advertisement. He brought it down and asked me what I thought of it. I said that it was all right, except the word "summer," which should be stricken out. After half a day's argument with the advertising man, he said he guessed he knew his business a good deal better than I did, and the result was that the word "summer" went in. You should advertise gas for fuel, not for summer fuel. As Mr. Moses said in the New England meeting, "I would talk gas for fuel and gas for cooking, and advertise its advantages over coal, oil and everything else." Talk gas as a fuel as against all other kinds of fuel.

MR. STONE:—It seems to me the question of installing gas stoves comes down to the proposition whether you can get your money back or not. We are all of us interested in the financial feature of the question. The way I figure it out is about this:

Suppose a gas stove costs $12, and the installation $18; then you have a total investment of $30 in putting in the stove. We give the man a gas stove. The average life of a gas range, we will say, is about four years. That would make the cost depreciation on the stove $3, and the interest on your investment at 6 per cent. would be $1.80, making a total cost of your investment $4.80. Assuming that you make a profit of 30 cents per 1,000 on the gas, you would have to sell 62,000 feet of gas on that gas range before you came out even, before you made any profit for your company at all, not taking into consideration the extra cost of making the service, the extra cost of clerical help, keeping the books, the extra cost of reading the meter or anything of that kind, but simply the actual cost, interest on investment and depreciation in stove.

MR. LYNN:—All that I have to say is, if the gentleman is paying $12 for a gas range that will only last four years, he is getting stuck.

MR. SCHWARM:—In regard to the life of a gas range, about a year ago our company went into the subject of gas ranges pretty thoroughly. We considered the question which is now before this meeting as to the advisability of giving away ranges. About five years ago the company was using at Lorain about 250 ranges, putting them out free of charge, and if you would make a canvass of that town to-day you would not find 50 in first-class condition. You could not find 50, I think, that you could sell for $1.50 apiece. Anything that you give away the people do not take care of. Now, if these ranges are in such shape that the people cannot use them again, we get them to come down to the office and we sell them a new range at cost, without much trouble. We discussed the matter on all sides about a year ago, and decided not to offer any free ranges at all, but offer them on a cash payment of $3 and $1 per month, connecting them up free of charge and selling the range at what it cost us. We have been getting along in good shape on that basis. Another matter I would like to suggest in this connection: I think we place too much stress on the range question alone. I think we ought to take up the question of hot plates as well as the ranges. The ordinary hot plate, three burners, will burn as much gas as an ordinary range. If you go into any family among the great majority of the gas consumers, you will find if they have a hot plate, that that hot plate is consuming gas 365 days in the year. If it is not going for cooking, then it is going

in the basement, the gas is used for washing, ironing and other purposes that your range is adapted to. I think we place entirely too much stress on gas ranges. The agitation ought to be along the general line of advancement for securing the use of all devices which will increase the consumption of gas, rather than along one particular line.

SECRETARY JONES:—I would like to ask Mr. Stone if the four years which he speaks of as the average life of a gas range is based on actual results as he has obtained them?

MR. STONE:—I do not do anything in the gas range business. That is, I do not sell them, and I do not handle them. I base my figures on the results that have been given me by other parties, so far as the four years are concerned. If you wish you can put it five years. I simply figured the matter in that way to give an idea as to the manner of calculating it. You can assume in that calculation that the average life of a gas range is anything you may desire. I simply was giving those figures for the purpose of showing the method of calculation. I think our experience has been about five years, but I put it at four, because it figured a little bit easier at four years.

GENERAL HARBISON:—I believe the average life of a gas range depends upon two things, first the quality of the range, second as to whether the party had it given him, or whether he had to pay for it. If it was given to him by the gas company, then the range receives no decent care. That is the information which comes to me from those who have been doing it. If they buy it the range is their own property, and it is to their interest to take care of it. These are the two things upon which the life of the gas range depends.

JOHN R. LYNN:—We have in our town a gas range that was given away 12 years ago; it has been given away twice, and it gives good results yet.

MR. ROPER:—I would like to say that the first 25 stoves put out in Rockford, Ill., were given away by my father-in-law 25 years ago. They were the old Providence retort stoves, and some of them are in use yet, and are in fairly good condition.

The Association then adjourned until 9:30 A. M., March 21, 1901.

Second Day.—Morning Session.

The Association met at 9:30 A. M.

The President:—The first order of business will be the report of the Committee on President's Address.

Mr. Andrews then read the following

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

To the Members, the Ohio Gas Light Association:

Gentlemen:—The committee to which your President's annual address was referred begs leave to present the following report:

We concur in the pleasing reports in regard to the continued use of gas, not only for general purposes, but also in what until recently was a lost field, namely, street lighting. The suggestion concerning a combination for the purchase of supplies and disposal of by-products is worthy of consideration by companies so situated as to make it possible.

The Novelty Advertising and Wrinkle Departments are sure to prove of the utmost benefit to our members, and should be continued.

In the earlier years of our Association, we were not in shape financially to go to the expense of publication of our proceedings in any permanent form; but the time has now arrived, in the opinion of your committee, to take up the matter and make arrangements for the publication of the proceedings of the past meetings. We, therefore, recommend that the Executive Committee make suitable arrangements for the undertaking, and that a volume be gotten under way.

This Association has long since outgrown the state of its birth, and now enrolls its new members from all parts of the country. There seems to be a particularly inviting field for new members in the states mentioned in our President's address, and we concur in his suggestion that in the near future the Committee on Place of Meeting carefully consider the advisability of holding it outside this state, as conventions in these sections would no doubt add largely to our membership and efficiency as an Association.

The very efficient and successful manner in which our Secretary has conducted the arrangements of this meeting fully deserves the praise which is given it.

In conclusion, we desire to express our approval of suggestions and our commendation of the spirit of confidence in the future usefulness of our Association and the continued success of our profession which runs through the address.

Respectfully submitted,

C. W. Andrews,
John D. McIlhenny,
J. H. Maxon,
Committee.

It was then moved, seconded and carried that the report of the committee be received and placed on file.

The President:—The next order of business is the report of the Committee on Next Place of Meeting.

Mr. Persons then submitted the following

REPORT OF COMMITTTEE ON NEXT PLACE OF MEETING.

To the Members, the Ohio Gas Light Association:

Gentlemen:—We, your Committee on Place of Next Meeting, beg leave to report as follows:

We have received with great pleasure urgent invitations from Toledo, Indianapolis, Cincinnati and Columbus.

We have discussed with various members of the Association as to the advisability of going out of the state. The general opinion seems to prevail that we are large enough in membership outside of the state to warrant meeting in a neighboring state. We, therefore, recommend Indianapolis as the place of our next meeting. If it is the sense of the Association that we hold the meeting in this state, we recommend Toledo as second choice.

We are not unmindful of the urgent invitation to go to Cincinnati or Columbus, but having recently held meetings in both cities, it seems advisable to move about and into new pastures.

Respectfully submitted,

F. R. Persons,
B. W. Perkins,
E. D. Abbott,
Committee.

Mr. Butterworth:—I wish the Committee on Next Place of Meeting, if it has it, would read the invitation from Columbus.

Mr. Persons:—I will be very glad to read it. The letter from Mr. Butterworth is as follows:

To the Committee on Next Place of Meeting:

Gentlemen:—On behalf of the Columbus Gas Company and the Columbus Board of Trade, I cordially invite and urge you to name Columbus as the next place of meeting.

Columbus is not only the birthplace and logical home of the Association, but it is very centrally located with reference to our membership, can be easily and quickly reached by many direct lines of railway from the various parts of Ohio and the surrounding states, and has the best of hotel facilities. I feel sure that a majority of our members would prefer Columbus to any other city as the next place of meeting. Furthermore, I think I can promise the members, if you should come to Columbus a year hence, a most interesting trip to Lancaster, where you may inspect the great gas wells of the Sugar Grove field and watch the operations of the 1,000-horse-power gas engine and pump described to you by Mr. Eysenbach this morning.

Very respectfully,

Irvin Butterworth.

Mr. Persons:—If a motion is in order, I move that the report of the committee be amended by inserting the words "City of Columbus" in place of the words "City of Indianapolis." I think it would please Mr. Doherty more, probably, if we met in Columbus —it is his native town—and I would, therefore move to amend the report by substituting Columbus for Indianapolis.

The motion was then seconded and unanimously carried.

The President:—The next order of business will be the reading of the report of the Committee on Memorials.

John R. Lynn then read the following

REPORT OF THE COMMITTEE ON MEMORIALS.

To the Members, the Ohio Gas Light Association:

Gentlemen:—Your Committee on Memorials would respectfully submit the following:

Henry Ranshaw, President and Manager of the Stacey Manufacturing Company, died January 30, 1900. Identified with the

above-named company since 1851, Mr. Ranshaw was deeply interested in the welfare of our industry, and, while unknown to a great many of our members, possessed a place in the esteem of his acquaintances that is commendable to all. His decease is deeply regretted, and the Association loses a member of sterling worth and intelligence.

George Treadway Thompson, that warm-hearted friend, genial companion and able practitioner, died at Denver, Colo., on the night of October 1, 1900, at the early age of 31 years. His career has been too closely woven with the recent history of the gas industry to require comment at this time. In the zenith of its brilliance, a great light has been extinguished, and yet we know that its reflection will extend on and on to remove the shadows for a future generation of gas engineers and managers. Words cannot express the true loss sustained by us in his departure. We simply leave him to your appreciative memories and thank a wise Omnipotence that his brief life and character were given mankind.

Herman Wilkiemeyer, a pioneer of this Association and one of its former Presidents, died at Cincinnati, November 20, 1900, at the age of 48 years. Always one of our most active and industrious members, ready at all times to aid in making our sessions useful and instructive, his genial face will be greatly missed at our annual gatherings. His successful business career, excellent citizenship and high personal character combined to make a man beloved and esteemed by his fellowmen.

WHEREAS, It has pleased the Great Author of man's coming and going to remove from us these friends; be it

Resolved, That this Association express its deep regret at the irreparable loss sustained; and be it further

Resolved, That we extend our heartfelt sympathy to their respective families and intimate friends, that this report be embodied in the record of this Association, and that a copy thereof be transmitted to the immediate family of each of the above deceased members.

Respectfully submitted,

B. E. CHOLLAR, *Chairman,*
JOHN R. LYNN,
JAMES E. STACEY,
Committee.

Mr. Butterworth:—I move the adoption of the report by a standing vote.

The motion, being duly seconded, was then unanimously carried by a standing vote.

The President:—The next order of business is a paper on

THE PROPORTIONAL STATION METER.

GEORGE W. BARNES.

In bringing this subject before the convention, it is my purpose to open a line for discussion, rather than give a lengthy paper on the "proportional meter."

A proportional meter is rather an old than a new machine, as we find as early as 1863 records of a device known as "an improvement in water meters," described as "a meter in which the fluid is divided into two streams—one relatively large, the other a small stream—in such a manner as to allow the small stream to pass through the meter and the large stream around the meter." Hence a proportional meter as known to-day. This was followed by many others, but with no marked success until a demand for a meter of this kind was created by the natural gas companies, then the matter was taken up to fill this demand. Then was found the difficulty that had been encountered in all earlier experiments, to-wit—the maintaining of a constant ratio of drop, or absorption, through the proportionate openings. The difficulty was finally overcome through long and discouraging experiments, which possibly some of us experienced, in part, at least. This, however, brings us to the proportional meter of to-day, and the consideration of its adaptability to the duties of a station meter.

Here let me briefly describe the operation of the proportional meter as we have it to-day: A represents the fluid inlet. The delivery chamber, B, is separated from the inlet, having an opening controlled by direct inlet valve 1. This valve is mounted on a stem which slides longitudinally, and moves with the flow of the fluid current to close the inlet opening. To the end of the rod is secured diaphragm 3, consisting of the usual center plate and flexible annulus, which is secured in the casing. C is a tally meter connected to the inlet, A. From the tally meter, the fluid, which has been measured therein, passes into chamber D. This chamber communicates with delivery chamber, B, by an opening which is controlled by valve 2, mounted on the same stem with valve 1. The area of

the openings for the meter delivery valve is made such that its ratio to the area of the opening of the direct inlet valve shall be equal to the ratio of the determined capacity of the tally meter to the volume of fluid passing through the direct delivery valve, so that under all degrees of opening of the direct delivery valve and the meter delivery valve, the proportionate delivery of the meter is constantly equal to the predetermined fraction of the supply volume with

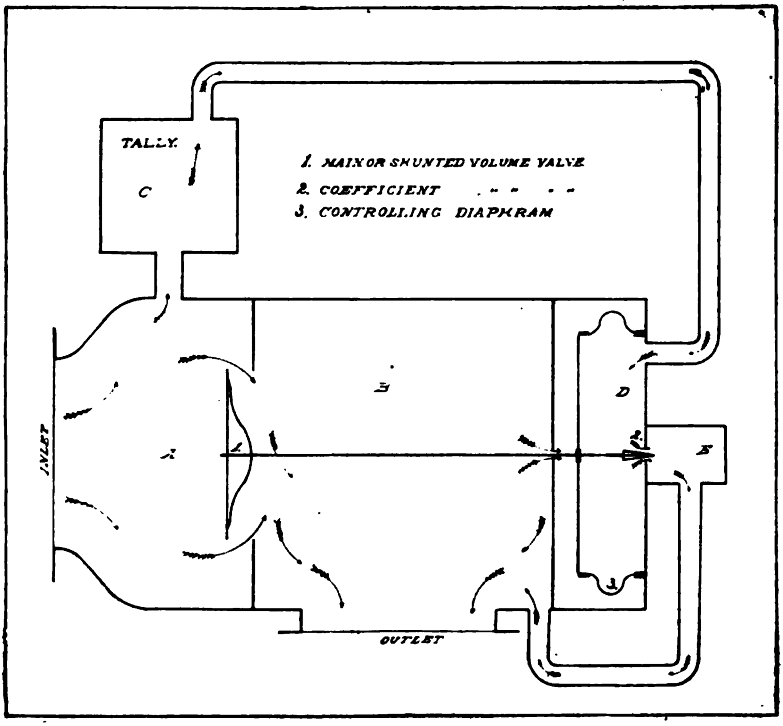


DIAGRAM SHOWING ARRANGEMENT OF PROPORTIONAL METER.

which the capacity of the tally meter accords. The effective area of diaphragm 3, which constitutes what is termed a "low-pressure plate," is greater than the effective area of the inlet valve 1, which in this form is bath a valve and a "pressure plate."

The operation is as follows: The fluid at A passes through tally meter to chamber D, until sufficient pressure has accumulated therein to actuate valve rod so as to move valve 1 into an

open position, this rod at the same time opening the meter delivery valve 2. The fluid then passes through the direct admission valve into the delivery chamber, B, and also by the way of tally meter and meter delivery valve 2 into same chamber, from which it passes into the outlet.

To maintain the required proportion of flow of fluid through the direct admission valve and the meter delivery valve, it is necessary that there shall be a constant ratio of drop. This ratio of drop in pressure is obtained and maintained by means of high-pressure plate constituted by valve 1 itself, which is opposed by low-pressure plate 3, of a greater area, which is acted on by less pressure, namely, that which is passed through the tally meter. These two pressure plates, acting in opposition to each other, force valve 1 to a position where equilibrium is established between the pressures acting upon the pressure plates. If the amount of the absorption of the pressure by the tally meter varies, it is evident that a corresponding variation of pressure will occur in the diaphragm chamber D, thus changing the position of the direct inlet valve and meter delivery valve to correspond thereto.

The difference in the pressures acting on the two plates, is of course due to the absorption of pressure by the tally meter. If the absorption of the tally meter is equal to 1-inch water column, then the difference in the pressure acting on the high-pressure plate and the pressure acting on the low-pressure plate will be 1 inch. In this case the drop through the direct inlet valve will be 2 inches, and the drop through the meter delivery valve 1 inch, and if the relative area of opening of the small valve is 1 per cent., the flow through these valves, being proportioned to their area and the square root of the drop through them, the volume per inch of area passing through the direct inlet would be 1.414 times the volume per square inch of area passing through the meter at delivery valve, since the square root of two equals 1.414, and the square root of one equals 1.

If the absorption of the tally meter should increase to, say 2 inches water column, the delivery of volume remaining the same, the pressure on the low-pressure plate or diaphragm would be reduced, and the pressure acting on the high-pressure plate would remain the same; the proportional valves would then be forced to a more nearly closed position until the pressure accumulated and equilibrium was again established, and the pressure acting

on high-pressure plate will be equal to 2 inches, and that on the low-pressure plate equal to 4 inches. In this case, the drop through the direct inlet valve is 4 inches, and the drop through the meter delivery valve 2 inches. The square root of 4 being equal to 2, and the square root of 2 being equal to 1.414, 2 divided by 1.414 equals 1.414, the same ratio as before. This, as you will see, leaves the question of accuracy to two features of the machine—the tally meter, and the parts free from obstruction by foreign matter.

This, gentlemen, I hope will bring before you the subject in a manner to call forth your expressions, which done, I leave it with you, with my thanks for your attention to the reading.

DISCUSSION.

THE PRESIDENT:—Mr. Chollar, I would like to have you discuss the paper.

MR. CHOLLAR:—I am hardly fit to start the discussion. Some of you know much more about the meter than I do. We have three ourselves; they have been delivered and have been tested, but we have not them in practical use yet. On the arrival of the meters we attempted to make a test, and for want of a better method we connected them in tandem or in series. We bolted the three meters directly together, and found by this arrangement that there was no correspondence whatever. The meters all measured differently, and in connecting the different meters in different order, there seemed to be no system whatever to it. They registered any way and every way; and after experimenting with them several days without success, we became considerably disgusted with them and thought they were no good. We sent for Mr. Wylie. He came out there, and I think he was a little stumped himself the first day. At least he didn't accomplish much the first day, but shortly after—I think on the second day—he separated the meters, putting the second meter probably 4 or 5 feet away from the first, and the third one probably 15 feet away. That allowed a full, free and even flow from one meter to another, which we did not have in the first arrangement. By this arrangement we found that the first meter and the last meter corresponded almost perfectly. There was so little error that it might have been overlooked entirely. They were practically the same. The middle meter did not correspond perfectly, but it was near enough for all practical purposes, and it might have been

used without a station meter nicely. Then by changing the meters in different combinations, the meter that was put first in the series and the last meter agreed perfectly; so that we are fully satisfied with them and think they are all right and will answer all practical purposes very nicely provided they are kept clean. They will require a little care in cleaning out the dirt caused by naphthaline or something of that kind. I doubt if they will require any more care than the ordinary station meter, because I have seen the ordinary station meter filled up with naphthaline inside the drum, which would prevent it from registering accurately. We have been well enough satisfied with the meters to put them into practical use, and they will be in operation in a few days. We fully believe they are all right.

James T. Lynn:—Did you try these proportional station meters on different flows? We have had some experience with proportional station meters in the natural gas business, and I find that they vary very much in the amount of the flow. That is, you take a meter with a capacity of 10,000 cubic feet an hour, and if you run it up to the capacity of 10,000 cubic feet, you will get a pretty accurate measurement, but if you are passing 1,000 or 1,500 feet through the proportional station meter you do not get good results.

Mr. Chollar:—We tested these meters at probably 10 or 15 different rates or possibly more, and we had no such differences at all. They were accurate at all rates practically; that is, they agreed.

Mr. Lynn:—Did you make a test with another meter?

Mr. Chollar:—We tested them in tandem, which I think was better than testing them with another meter.

Mr. Lynn:—Of course, there may have been some improvements made on them since the test I refer to. It was two or three years ago that I had some experience with them.

Mr. Chollar:—When they are adjusted and properly tested, I think you will find them satisfactory. If a meter should be made and not adjusted for a low rate or a high rate, it might not register correctly; but when a meter is properly adjusted for all rates I think it will register correctly on different rates.

John R. Lynn:—I would like to ask Mr. Barnes if a meter which is made to take care of a high rate of consumption will register correctly on what we might call a minimum volume per hour.

Mr. Barnes:—A good deal would depend on the instructions

that the meter maker would get in building his meter. The method of testing all large machines is, that you test them for the work that you suppose they will do. When you get down to, say, 200 or 1,000 feet per hour, with a proportional station meter, you are approaching house meter volumes. While it could be tested down that low, I don't believe any proportional meter builders make a habit of testing that low, unless by special request. They could be made so as to be adjusted to a very low volume. It requires considerable work, but they can be made to do that. Then that will make your meter accurate between two extremes.

MR. STONE:—I would like to ask how low a pressure a proportional meter is supposed to work on and what would be probably the maximum drop that would be necessary to make it work accurately.

JOHN R. LYNN:—We have had experience with two proportional meters, and the results were widely different in the two cases, and yet I think the matter might be explained. That is, it was between the relief holder and the holder which fed the city, and I presume the gas passed through at a pressure of somewhere between 6 and 8 inches water column. I graduated the holder and found the meter registration was as nearly perfect as we could expect with another meter. We placed one at Bellevue, and I think Mr. McMillen had quite a little difficulty with it. Instead of placing it on the inlet of the holder, we placed it on the outlet, so that it measured the output of the plant. I think in that case the pressure was about 2.5 inches.

MR. MCMILLIN:—Three inches.

MR. LYNN:—Three inches water column. I think it registered about 30 per cent. of the gas that passed the meter.

MR. MCMILLIN:—It varied. Sometimes it would register under, and I remember in one or two instances it registered probable two or three times the output, so that we could not rely upon it in any way.

MR. ANDREWS:—I would like to have an answer to Mr. Stone's question if Mr. Barnes can answer it.

MR. BARNES:—The drop varies as to the volume passed. The total drop of the meter, as you will see by the paper, is double that of the tally meter. You put a tally meter on a building meter. The total drop of the meter is always, as I before suggested, double that of the tally. If your coefficient volume or your measured volume, is 0.5 per cent., or 1-200, and you are passing 100,000

feet an hour, then you take 1-200 of that. Then the absorption of your tally meter at that volume, through the tally meter, equals one-half the drop of the total meter, so that it is comparable on that basis with what passes through the ordinary house meter. To come down accurately, you can pass 150,000 feet of gas through a proportional station meter on 1 inch of drop. That is the maximum drop for that flow of gas. Then possibly if you were passing through the same machine, say, 50,000 feet, your drop would be four-tenths. The variation is between these two, and as you get below 50,000, the drop decreases until you reach the minimum of your tally-meter drop.

MR. EYSENBACH:—I would like to ask how they test these meters? I believe I have heard that they have a special means of testing them, that is, a usual method of testing them. Do you know anything about that, Mr. Barnes?

MR. BARNES:—Have you reference to the testing by the builders, or a test in your works?

MR. EYSENBACH:—A test in the works.

MR. BARNES:—I would suggest in that case a test similar to the one we use. That is, by a flow meter. It is rather a long explanation for me to tell you how the flow meter was built, but I can tell you the operation of it very briefly. Where you want an absolute test it is the only method. The method is this: We have a large drum, say, 48 inches in diameter, with an interior drum of about half that diameter. The interior drum is perforated with as many small holes as we can get in the sheet. The outer one has calibrated holes, giving a certain flow with certain pressure. For instance, take one with a 1.5-inch calibrated hole through a 1-16 thickness of plate, with the thermometer at 70 and the barometer at 30, and you will get exactly 1 foot per second with a 4-inch pressure. Now, the only adjustment necessary to maintain that is the adjustment of pressure to suit the atmospheric conditions. For instance, we find that the thermometer is 60 and the barometer 29.3. Then we figure the exact amount of pressure to be required to pass this flow of 1 foot per second through the orifice, then we start the meter; we start a constant flow through the meter, which also passes through the flow meter against the atmosphere. The flow would then be exactly 100 feet in 100 seconds. We gage the hand of the meter with a stop watch. We stop the watch when it has exactly reached 100 feet. If it has required 105 seconds for the 100 feet to pass, then the error is

5 per cent.; if it has passed in 95 seconds, the error is the other way 5 per cent.

MR. EYSENBACH:—What did you say the pressure was?

MR. BARNES:—The barometer at 30 and the thermometer at 70. Then we regulate the pressure to suit the atmospheric conditions. That pressure is controlled by a very sensitive governor. It is held constant after we have determined the pressure. For instance, we may find one day the pressure required is 3.95 inches of water pressure, and we set our regulator at that and maintain it constantly. Possibly the next day it will require 4.5 inches of water, and so on.

JAMES T. LYNN:—How do you test these meter provers? What system do you use to prove them?

MR. BARNES:—I intended to give that, Mr. Lynn. The method is this: We have a very accurate prover which we know by both Government tests and our own tests to be a very accurate 100-foot ordinary prover. We made this drum, as I described before, put it on the prover, and for days—I do not know how long a time—a very competent man took charge of it, and he found that the result obtained that way was absolutely correct; it took through this orifice just one second for 1 foot of air to pass at a pressure of 4 inches. Now, just to carry that a little farther. There are a number of these holes—enough to carry on the test as far as you want to carry it. These holes are stopped perfectly tight with plugs, and each one represents just so much—100 feet in 100 seconds. Then you take out one plug and allow that to run. That is 3,600 feet per hour. They test that, then take out another, and go right up by stages 3,600 feet at a time. That is the usual method, to start at 3,600 feet and then go back for a low test to just one-half of it, or what is called a "half-hole." When you get down to 200 feet an hour or 300 feet an hour you are below the volume for which the meter was intended to work, and it is liable to be anything at all. Unless specially requested, as I stated before, I do not think that any proportional station-meter builder would run a meter down below about one-twentieth its capacity.

JAMES T. LYNN:—My experience, of course, has been principally with natural gas, where the consumption varies. For instance, in the water works of Detroit, the consumption there would vary. They had three boilers, two large boilers and a small one; the large boilers were about 250 horse-power and the small one about 50 horse-power. We found, when they were running the

50-horse-power boiler, they were getting gas for about nothing; that the proportional station meter was registering hardly anything. When they had the full load on we were getting about what was due us. I have had experience with about 20 or 30 proportional station meters and I have never found one of them I thought was satisfactory.

MR. SCHWARM:—I would like to ask if about three-fourths of the natural gas that is sold to the large manufacturers at Pittsburgh is not measured through the proportional station meter?

MR. BARNES:—I would just state this, since you have asked that question, that every foot of it that is sold in Pittsburgh to-day and for the last ten years is measured in that way. Am I not right, Mr. Holmes, in that statement?

MR. HOLMES:—Yes; I should think about 10 years.

MR. SCHWARM:—Have they practically done away with all the large old-style meters?

MR. BARNES:—There is not one in use in Pittsburgh.

MR. LYNN:—That does not coincide with the statement made by Robert Young. He told me not three months ago, in talking about the proportional station meters, that he had not struck one yet that was correct. They were about as near as anything that could be obtained, but he said there were none of them correct. Of course, I do not wish to "knock" the proportional station meters, but simply state what he said.

MR. BARNES:—I understand that, Mr. Lynn, but the question that I answered was as to whether they were using proportional station meters entirely at Pittsburgh in the measurement of gas. I said they were. That is the question I answered.

MR. BUTTERWORTH:—Mr. President, I move a vote of thanks to Mr. Barnes for his very valuable paper. (Seconded; carried.)

THE PRESIDENT:—We will now have the report of the Committee on National Advertising Bureau.

Secretary Jones they read the following

REPORT OF THE COMMITTEE ON NATIONAL ADVERTISING BUREAU.

To the Members, the Ohio Gas Light Association:

GENTLEMEN:—Your committee on establishing a National Advertising Bureau begs to report that the matter was presented to the Western Gas Association at its May convention in Chicago, and E. G. Pratt, of Des Moines, Ia., was appointed as the representative of that Association. The matter was also presented to

the American Gas Light Association at its October convention in Denver, and Frank G. Moses was appointed as representative of that Association. The committee has never had a meeting owing to the present unfortunate geographical situation of its members, but a meeting will be attempted just prior to the Western Gas Convention at Louisville.

The scheme meets with the unqualified approval of many prominent gas men, and new converts are continually being heard from. It was found impossible to put the matter on an active basis for the present season's work, and during the present season nothing more can be done than to continue the investigation and popularize the movement.

Arrangements have been made with certain advertising houses to obtain from them statistics bearing on this subject. Several of the larger gas companies are going to extend the amount of their local newspaper advertising and others will inaugurate an advertising campaign for this season for the first time. These results are partially due to the agitation of this National Advertising Bureau, and the good results of more general advertising of gas cannot but benefit the whole gas business even though the advertising is confined to the local papers. Many of these papers find their way into the hands of the consumers of other cities, and communicaton between these and other cities cannot but help the gas business elsewhere. The more advertising talent devoted to pushing the gas business, the better will this class of advertising become. Many remarkable examples can be cited of the efficacy of proper advertising. The results obtained last season from the advertising of blue-flame oil-stoves by the Standard Oil Company were nothing short of sensational. If clever advertising will sell an article of no greater merit than the blue-flame oil stove, how much more effective would it be for gas stoves? The average revenue from gas stoves exceeds $20 per annum, and it has been found highly profitable by manufacturers of other articles for household use, to expend over $100,000 per annum to promote sales of commodities whose consumption per household cannot exceed $3 per annum and sometimes less than $1. Soap, baking powders and patent medicines are amongst the most marked examples of the results that are obtained from lavish yet judicious advertising.

The use of gas for fuel purposes can only be made universal by creating a universal want for it, and all the people cannot be

reached except by fetching "Ads." so placed and designed that they will be read.

It is estimated by experts in advertising that not less than $50,000 would be required for one season's advertising, such as would bring results which would leave no further question of the profitableness of the venture. This amount looks large in the aggregate, but will prove insignificant to each gas company if a sufficient number will participate. Success in this movement will only be possible by the active support of those favorable to the scheme in convincing the skeptics.

Respectfully submitted,

HENRY L. DOHERTY, *Committee.*

Denver, Colo., March 5, 1901.

THE PRESIDENT:—Gentlemen, what is your pleasure with respect to this report?

MR. HAYWARD:—That seems to be a report on progress, is it not?

THE PRESIDENT:—Yes.

MR. HAYWARD:—He refers to the meeting of the committee before the Western Association at Louisville. I move you, therefore, that the report be received and filed and that the committee be continued. I will also include in that motion a vote of thanks to Mr. Doherty for his diligent efforts in this matter. (Seconded and carried.)

QUESTION BOX.

THE PRESIDENT:—Question 15—"Can a by-product coke-oven plant be successfully operated in an Ohio town of over 100,000 population?" I will call on Mr. Butterworth.

MR. BUTTERWORTH:—I do not know, Mr. President. I think it would depend a little bit on the local conditions and the coke market at that particular place, but I should think ordinarily it would be.

MR. ANDREWS:—I would say, gentlemen, that we are constructing a plant in our city, but we have not completed it yet. I am, therefore, not in a position to say just what the results will be, but I should judge, as Mr. Butterworth says, local conditions would govern. I think the question of a market for by-product is what would govern as to the advisability of putting in a plant

of that kind. If you could sell the coke at a good figure, as well as the other by-products, there is no reason why it should not be a paying venture.

MR. COOMBS:—This question speaks of a town having a population of about 100,000 people. Right near Youngstown is a by-product coke oven running in a town of about 10,000 people.

MR. BUTTERWORTH:—Is it a success?

MR. COOMBS:—Yes, I understand it is.

JOHN R. LYNN:—I suppose you can find coke ovens running in smaller places than that, but the purpose of the question is whether it would be advantageous to somebody doing a gas business.

MR. COOMBS:—That is true, but this question relates to a city having a population of 100,000. Of course the question of conducting a by-product coke oven in connection with the gas business is another question.

MR. HOLMES:—I do not see why a by-product coke oven in a city of 100,000 people should not pay well. I understand that the gas from a by-product coke oven is practically of "velvet." The coke is usually readily sold, and in a city with a population of 100,000 people, you usually have a great many good houses. If it is a natural-gas town, you could figure about 20,000 connections, calculating about five people to each house, so that if you had only 50 per cent. of that, there would be 10,000 connections, and if you could sell your gas to 10,000 people you would certainly have a very nice revenue from it, and the revenue from your by-products would be a very nice thing for any gas company. So that I believe in a city of 100,000 people it would be a very good scheme financially.

JOHN R. LYNN:—Mr. President, to go into the coke business, you bump up against people who are already in that business and who have established a commercial trade. It might be all right if somebody had the money to put into a place of that kind to run a by-product business, but in so far as a gas company taking it up, I doubt very much whether it would be practicable.

JAMES T. LYNN:—I do not think selling coke would cut any figure at all in this matter. If any body in a town of 100,000 inhabitants wants to go into the business, it is a question of location and conditions. I think the matter of securing coal at a sufficiently low figure is a very important question. I think he can get rid

of his by-products all right, but the very important question is whether he is located conveniently to the coal fields.

MR. PERSONS:—He might move the town down to the coal fields.

MR. LYNN:—If he would move the town down into West Virginia somewhere he would be all right.

THE PRESIDENT:—Question 14—"What is the best roof for a retort house? If slate, how fasten it?" I will call on Mr. Butterworth.

MR. BUTTERWORTH:—I remember answering that question once before in this Association, but they do not seem to have followed my advice. I do not know whether General Harbison's advice—which he says he gives away—is received any more favorably than mine or not. I would put on a board and gravel roof—board and felt covered with gravel. We have one of that sort in Columbus, and it has caused us no trouble whatever. It has been on for some years. It is an inexpensive roof, does good service and does not corrode. It is high enough above the benches so that it will not get afire. We have no trouble with it whatever. It is very cheap and it lasts a long while.

THE PRESIDENT:—That answers the first part of the question, but in case you have a slate roof, how are you to fasten the slate on?

MR. BUTTERWORTH:—You won't have to use slate if you follow the advice just given.

MR. SCHWARM:—I used slate and fastened it on with copper nails—nails put in from the top and bent around. They have proved very satisfactory. We never have a bit of trouble with it, and it is water tight.

MR. SOMERVILLE:—Copper nailing does not suit in my experience as well as lead wire. I had some experience on this subject some years ago, and I used lead wire about 0.25 inch thick. It comes in reels something like small lead pipe, and you can take off a piece, cut it off the required length, put a head on it, make it straight and then twist is around the rafter. That is the best thing I ever got for the purpose of fastening slate on a retort roof. We have had no trouble since and it has lasted for a number of years—I cannot tell how many. Not one has given way, and it is so easily mended and handy.

MR. ANDREWS:—We have just finished putting on some roofs of Ludowici terra-cotta tile. I think that is the coming roof for

places where there is a great deal of moisture and corrosion from evaporation. It is made, as you well know, of burnt clay, in the regular form of a brick, and it has an offset which fits down just above the angle iron, preventing the roofing from sliding down; so that all you have to fasten it down for is simply to hold it against the wind. It has a small hole in it to run a copper wire through, and fastening that down over the angle iron, you have a roof that ought to be practically indestructible. You can also get glass tile as well as terra-cotta tiling, to work right in with the other, so that skylights can be put anywhere in the roof as desired.

MR. MAXON:—I would like to ask Mr. Somerville where that lead wire can be obtained.

MR. SOMERVILLE:—I got another party to procure it for me, and I do not exactly know where he got it. I can easily ascertain, and will let you know.

MR. CHOLLAR:—I understood Mr. Somerville to say that the wire was 0.25 inch think. Isn't that a pretty large wire to fasten slate on with?

MR. SOMERVILLE:—I would not be sure about that, but I think that was about its size.

MR. LYNN:—I had some experience with a retort house roof in a cyclone district of southwestern Missouri. I have been raised in practically the same school as Mr. Somerville, who speaks about using lead nails. We have always put our retort house roofs on with lead nails. I put one on out in Missouri last year with lead nails, and about the time the roof was finished we had one of our gentle breezes blow out there, and half of it went down on the sidewalk. It straightened the lead nails right out. The nails were about 3-16 inch thick, and they were fastened on the purlins through the slate. The purlins were made of angle iron, with the flat part of the angle iron lying up to the roof, so that the lead nails not only came under the angle iron, but came around and fastened on top again. Still the wind took it off, so I took the whole roof off again and put it on with copper nails. I don't know how it is going to stand corrosion, but it has been my experience with lead nails that there is danger of the roof blowing off. We have had large wind storms since.

GENERAL HARBISON:—Some 12 or 15 years ago I built a retort house in Hartford, and it has had a varied experience. We decided that the best was none too good, as in all other matters. We bought a very superior quality of Vermont slate, 22 inches

long, and put them on with a double lap. We got lead nails about 3 inches in length and 3-16 inch in diameter, with flat heads, and with a pair of pincers the men wired those slates down around the purlins, and in 12 or 15 years of use we have never discovered a loose or broken slate. We have tried almost every other means of attaching them to the roof, and had a great deal of trouble previous to that time in fastening the slate securely. It has proven eminently satisfactory.

MR. LYNN:—What kind of plyers did you use in fastening these nails under the purlins?

GENERAL HARBISON:—Just ordinary pincers were used by the men in putting them on. They could bend the nails right around the purlins without any difficulty, perhaps a 0.75 inch purlin; perhaps it might have been an inch. It has been so many years since it was done that I do not remember, but perhaps 0.75-inch purlin. They bent them around the sharp corners with no trouble whatever.

MR. LYNN:—Did I understand that you used an inch purlin for a 22-inch slate?

GENERAL HARBISON:—I said I could not remember the size, because it was so many years ago, but the purlins were such as were put on by Bartlett, Haywood & Co., of Baltimore, who did the iron work on the roof, and they used their judgment in the dimensions of the iron work more than mine.

MR. STONE:—I was the gentleman who asked that question and wanted the information, and I have gotten it. I am much obliged to the Association for the diversity of opinion which has been expressed. When I went to Ashtabula the roof was put on with iron wire and that bursted off and we put it on with copper nails and for some reason part of the roof came off. It seemed to corrode. Then we got some lead nails and put it on with them, and then the slate blew off. So that now I presume we will be forced to try the advice given by Mr. Butterworth and use something like he suggests. I had about concluded to put on a wooden roof with tar and gravel, but I wanted some backing before I presented the matter to my company.

GENERAL HARBISON:—The question of roofs to our buildings is a very important matter. For many years we thought in Hartford that there was nothing but the slate roof fit to put on. In the past half-dozen years we have, from practical experience, changed our minds. We now use on our roofs, where we build or

repair, corrogated iron with asbestos covering underneath laid on a mesh of wire to keep the paper from sagging. No matter what the building is used for, purifying houses, meter houses, coal houses, or any other house, there isn't a particle of moisture which drops from the roof on the floor. This paper takes it all up. I am not advertising any concern and I am not interested in any of that kind of business financially, but if any one desires information in regard to it, he can get it from what is now, I presume, the American Bridge Company. It is *par excellence* the finest thing I have ever seen.

The Association then adjourned until 1:30 o'clock of the same day.

SECOND DAY.—AFTERNOON SESSION.

The Association met at 2 P. M.

THE PRESIDENT:—We will first consider the paper of Mr. F. W. Stone, of Ashtabula, O.

The author then read his paper upon

BUSINESS OUTSIDE THE USUAL CHANNEL.

F. W. STONE.

In January the writer came across an article in one of the leading periodicals of the United States, describing the house that was to be built in 1950. The house described had all the conveniences, was just such a house as every gas man ought to occupy, yet if that were the case, the gas man's goose was in more senses than one electrically cooked, because in all that house they had no use for gas, not even in the kitchen.

I do not believe that the article as written is a true representation of the possibilities, but the public press and exhibitions are constantly putting forward electricity and its advantages, and the improvements made in that line. The oil interests are actively engaged in pushing forward the various forms of vapor incandescent lights. There is also a growing demand for cheaper gas. All these things will undoubtedly affect our business. We are now selling more and better gas than ever before, and shall continue to do so, as the past history of the gas business teaches us that competition only stimulates us to better work, and the discovery of newer and better methods of manufacture and use.

The use of gas for industrial purposes offers a great field for future development. We have tried this field in the installation of gas engines, but have been checked somewhat by the high price of the engine, the fact that a rate of 60 cents per 1,000 cubic feet must be made to compete at equal cost with gasoline, and the disposition on the part of some manufacturers to push the sales of gasoline engines as against gas. It is to be hoped that these objections can be overcome.

FIG. I. SINGLE GAS FORGE FOR HEATING ENDS OF BLANKS FOR FORGING AND WELDING.

The common peanut warmer outside the fruit store can be arranged to use gas, and become a customer of from 3,000 to 5,000 feet per month. If this same consumer can now be induced to have his peanut roaster fitted up to use gas, he will add about another 5,000 feet to his bill. If in addition to this, he has a room for ripening bananas, and you can persuade him to use gas for

heating it, you can get another bill for about 5,000 cubic feet. For all these purposes gas is an ideal fuel. The heating is easily regulated, and the cost low. Its only competitor is gasoline.

A great many grocery stores now roast their own coffee. It is not very expensive, 45 pounds of coffee being roasted in about 50 minutes, with a consumption of about 65 cubic feet of gas. The writer has one grocery that uses over 4,000 cubic feet of gas per month for this purpose alone.

FIG. 11. DOUBLE GAS FORGE FOR HEATING ENDS OF BLANKS FOR DROP FORGING.

You are all familiar with the ordinary blast gasoline furnace used for heating soldering irons in a tinner's shop. They roar so loud that the men at work can hardly hear themselves think. Sometimes they blow up. And they consume about 1 gallon of gasoline per day of about 10 hours. The writer had a great deal of difficulty in getting a soldering-iron furnace using gas as fuel

that was a success, but they are now made to do good work. A furnace consuming about 8 cubic feet of gas per hour will heat a set of 4-pound irons just a little faster than a tinner can use them. This is cheaper than gasoline—no noise or danger, and in the case of a firm doing job work, no lost time waiting for the gasoline generator to warm up.

We have not as yet reached the point where we can successfully use gas as fuel for generating steam in a boiler, except in cases of small boilers where they are used intermittently, and where the convenience is enough greater to warrant the consumer in paying the extra expense.

It is to be presumed that you are all familiar with the use of gas as fuel in ceramic kilns, pure water stills, and blow pipes for brazing bicycle frames and other purposes.

In the field of specially applied brazing furnaces and forges there seems to be a great opening for the gas business. It is however, difficult to give comparative costs, owing to the seeming great variation between the theoretical value of fuel used for these purposes and the actual results obtained. Each furnace or forge seems to be a law unto itself. In the writer's experience for this work, the average seems to be that 2,000 feet of coal-gas is equal to from 12 to 16 gallons of fuel oil, or from 300 to 500 pounds of coke. The economy, however, comes from the greater amount of work that a man can do with gas.

A furnace arranged for brazing ferrules showed the following comparative results per day's work:

With Coke.

Wages, man and helper	$4 00
400 pounds crushed coke	80
Extra help, wheeling coke and ashes, estimated	20
	$5 00

Results: 2,500 ferrules brazed; cost per ferrule 0.2 cent.

With Gas.

Wages	$4 00
2,000 cubic feet of gas, at 75c, per 1,000......	1 50
	$5 50

Results: 3,300 ferrules brazed; cost 0.16 cent each.

The number of defective ferrules made in a gas furnace was not 10 per cent. of the number in a coke fire. This same furnace consumed 16 gallons of fuel oil for the same work. The furnace for brazing ferrules was made after the pattern of the forge shown in Fig. III; the gas and air being mixed and entering at one end into the combustion chamber of the furnace, the heat then passed through the openings in the fire-brick top. The ferrules are placed over the openings.

FIG. III. GAS FORGE FOR HEATING BUTTS OF FORKS FOR SHAPING.

A forge equipped for heating small steel blanks for drop forgings showed the following results:

Using Coke.

Wages	$4 00
500 pounds crushed coke	1 00
Extra help	20
	$5 20

Results: 2,000 forgings; cost 0.26 cent each.

With Gas.

Wages	$4 00
1,700 cubic feet of goal-gas at 75c. per 1,000..	1 28
	$5 28

Results: 2,700 forgings; cost 0.19 cent. each.

This forge consumed 14 gallons of fuel oil for the same work.

In addition to the economy of operating, a gas fire is better than a coke fire, because the heat can be so adjusted that it is impossible for the workmen to burn the steel.

FIG. IV. GAS FORGE FOR HEATING PERFORATED SHEETS, ETC., FOR BENDING AND SHAPING.

Figs. I and II show single and double forges for heating the ends of the irons for drop forging or welding. In this case the combustion chamber is at the bottom, and the heat is passed out through the side at the top. The ends of the irons to be heated

project into the flame. In the case of small blanks for drop forgings, this is reversed, the flame entering the side at the top, and playing upon and completely enveloping the blanks, which are placed on a fire-brick slab in the bottom.

The furnace shown in Fig. IV was designed to heat sheets of perforated metal or other flat pieces of metal for shaping. The flame enters the bottom at the front, and is spread out in a thin sheet all under the work, returns back over the top of the work, and the products of combustion escape through the top of the furnace.

FIG. V. GAS-COKE FURNACE FOR HEATING HEAVY FORGINGS.

At the quoted prices for gas, there is no economy in operation obtained by substituting gas for fuel oil, but there is considerable difference in the cost of installation. A fuel-oil plant requires tanks for storage of the oil, an air compressor or high-pressure blower to maintain the required pressure and other expensive machinery. It is also almost necessary to have a man to look after the plant. In the installation of a gas forge it is only necessary to

have a good supply of gas of even pressure, and a strong, steady air blast. While a positive blower is the best, yet a Sturtevant or other fan that will maintain an air blast of 4 ounces pressure or more will work satisfactorily, and in some cases a pressure of less than 4 ounces will give very good results. The burner should be so constructed as to give the best possible mixture of air and gas. The size of the forge or furnace used should be as small as can be made, and still heat satisfactorily the articles required. The consumption of gas increases very rapidly in proportion to the size of the furnace used, and it will usually be found that the best economy is obtained by heating a small number of blanks rapidly rather than to spread the flame and try to heat a large number. A gas forge or furnace, to be a success, must also be designed especially for the particular size, kind or class of work desired. So far, gas forges are not a success when intended to be used on all classes and sizes of work.

Some authorities have stated that it was impossible to make a good weld with iron or steel heated by coal-gas, on account of a deposit of magnetic oxide scale on the metal. This may be true for large pieces, but the writer has found no difficulty in making a strong and satisfactory weld on bars up to one-half inch in diameter. While economy in consumption is to be desired, yet the chief advantage of the use of gas in industrial purposes is the large saving of time. A workman can in almost all cases do from one-third to one-half more work with a gas fire than with any other. The ability to control the heat is also quite an item, as some mechanical operations require that the temperature be adjusted very closely.

The writer is not satisfied but that better results than those indicated can be attained. Undoubtedly, in the future, improvements in the methods of constructing burners and the appliances for using gas will be made, and it is hoped that the next few years will see a great advance in the use of gas for the purposes outlined. It is impossible within the limits of a paper of this kind to go thoroughly into the subject. In addition to the uses which have already been enumerated, gas may be used for tempering and hardening dies and tools for rivet heating, for melting metal, for candy boiling, for heating enameling ovens, and ventilating rooms.

If the writer can provoke an interest along this line, the object of the paper will be achieved.

DISCUSSION.

MR. PERKINS:—I haven't very much to say, Mr. President, except that I concur in the remarks of the writer. Gas is used to some extent in our place for the same purpose that he has used it. It is used for ripening bananas, peanut roasters, etc. It is also used largely in a mechanical way, and we are putting forth our best endeavors to extend its uses for such purposes along all lines. It is simply a matter of ingenuity on the part of the men charged with the duty of adapting it to these various purposes.

MR. ANDREWS:—This subject is one of very great interest to us, especially in view of the stand taken by Mr. Stone yesterday with reference to the matter of gas stoves—that there were other methods of increasing the consumption of gas besides giving away stoves. I have had quite a little experience in our city in the use of gas, especially for soldering in the making of tin cans. We have a very large plant, which uses as high as 20,000 feet every day when busy in soldering tin cans and such other purposes to which it can be put. This field has really just been entered upon, when you consider that in all our cities there are a great many forges and shops of that kind where tempering is done and where they can use gas to a very great advantage if it is presented to them in the proper way, so that they can see the practical results and efficiency to be obtained from its use. A few more papers on this line, giving striking examples of how people do things in this way, I think, would be of great advantage to us.

MR. OLDS:—Mr. President, this paper has been very interesting to me. There has not been much of an effort made towards securing consumers to use gas for fuel purposes in our city, except for use in the gas ranges. Right close to our works we have a very large caramel factory, but unfortunately for us, I think they use electricity for such purposes. The paper, however, furnishes us all with some very good ideas which may be of advantage to us some day.

MR. CLAPP:—I have had some experience along the line of going outside for securing consumption in our various factories. We have quite a large bicycle works in our city. This spring their gasoline machine blew up or burnt up, and they needed something to go on with their work. It was right in the midst of their busy season, and they called on me to see what I could do with reference to furnishing gas. I undertook to furnish them gas, and

to-day we are furnishing them nearly 40,000 feet of gas per month for soldering, enameling and brazing. Everything they do in that line they are now doing with artificial gas. Mr. Stone spoke of peanut roasters, bakeries, etc. We have attempted to utilize gas along these lines. I cannot call to mind all the new devices, but there are a good many, and there are a great many others, I think, yet to be discovered, and which will all prove of profit to us.

MR. SOMERVILLE:—Mr. President, I think the paper we have just listened to is a complete answer to the pessimistic business we were hearing yesterday. The speaker mentions the subject of ventilation. I wish to mention a matter that occurred a few weeks ago. A minister complained about the ventilation in his church; the people went to sleep during his sermons; he could not keep them awake, and he asked me if I could suggest any way of ventilating the room. I told him I thought I could, and I constructed a little contrivance that I put in the ceiling—something that looked like one of those sun lights—and then constructed an arrangement that would cause a draft. In that apparatus I put two jets of gas, which, of course, rarified the air and made a complete draft. He was greatly pleased with it. The vacuum, of course, created a current and brought up the foul air into the open air. A draft occurred all the time. One of the public school commissioners got on to it and spoke to me about it, asking whether such a contrivance could be put into the public schols. I said there was no difficulty at all; that I believed that was the very best arrangement to secure ventilation in a building of that kind. I have an idea that this little thing—which might, perhaps, be more perfectly arranged than I arranged it—could be introduced into the public-school system of the city. It is very inexpensive. It is only lighted up a little while before the congregation comes, and, of course, if it does good work in the church it will do equally well in a public hall, school building or such places. I just happened to think about it as the speaker mentioned the subject of ventilation, and I throw out the suggestion for what it is worth. Of course, it increases the consumption of gas so much, and in that way will be of profit and advantage to us.

GENERAL HARBISON:—That thought of ventilation is a practical one, and is only another illustration, I apprehend, of the benevolence of the gas men. Why, Mr. Somerville, with his inventive genius, has certainly given the clergyman of that church \$1,000 or \$2,000 a year more salary, because the people have been kept from

sleeping—not because of the dullness of the sermon, but because of the atmosphere in the room. The sermon heretofore has not been appreciated, but the congregation now will say he is preaching so much better than he did before, that we must increase his salary or we will lose him. It is a practical thought and is worthy of our consideration. Mr. President, why will not the gentlemen who read papers to this Association, and who have discovered and alluded to a good thing which they have found from practical experience to be of value to them, be kind enough to give us the name of the article and the maker of it, that we may take advantage of it also? My friend Mr. Stone tells us in his paper about a soldering furnace that he has found to be of great practical value to those who have used it. How in the world are we in Connecticut going to know whose furnace that is unless he tells us. If he had gone one step further, and in the kindness of his heart, had told us whose furnace it was, where it could be procured, and at what cost, he would not have fallen short in furnishing the information the other members of this Association much needed in order to avail themselves of similar devices. That is what we are here for—to get this practical information and profit by it when we go home. I would like to know what furnace that is. One thought further. Has any one here had any experience in his own blacksmith shop in the use of gas instead of coal for blacksmith work? Can we not devise a means whereby gas may be utilized in the blacksmith shop, so that we can compete with coal? It is a continuous operation, 10 hours a day for 312 or 313 days a year, counting out holidays, which we are getting very rapidly for everybody but the gas manager. Has anything been accomplished in this line? Who knows about it if there is such a thing? Who can tell us how we may get one so that we can put it into practical working?

Mr. Stone:—I would state in reply to General Harbison that the gas soldering furnace I am now using I got from the Milwaukee Gas Stove Company. I did not mention it in the paper because I did not wish to advertise any particular make or firm. However, that was the one that proved the most satisfactory, as far as we were concerned. As far as a furnace for ordinary blacksmith work is concerned, I hardly think you will find gas practical for it on account of the inability to heat the iron economically. What I am getting at is, you would have to make a furnace so large to handle your large work, that when you came to handle

small work you would be wasting too much gas. In order to make a gas heating furnace for forging I suppose you want to have it as small as you can get it for the work you are going to do. If you are going to heat a given size iron right along, you can build a gas furnace securing very satisfactory results, but if you have to work upon different sizes, I think that will be a difficulty which you will encounter.

General Harbison:—Would not that difficulty be overcome by having two forges, one for the small work and one for the large? Again, could not these furnaces be introduced into the blacksmith shops over the city and in that way largely increase the consumption of gas? Now, as to this particular soldering furnace which Mr. Stone alludes to, the party who makes it ought to be ashamed of himself for not already having informed the gas industry of its existence and what can be accomplished with it. Why do they not publish the fact and advertise it so that we will know what it is, where it can be obtained and what it is expected to do? That brings in, incidentally, the scheme of advertising which was mentioned heretofore in this meeting. Why don't these manufacturers, who are making their living by the manufacture of devices which use gas as a fuel, let the public know where they can get those devices, what they are doing and what they are designed to accomplish, just as the patent medicine man is advertising his medicines, that my friend alluded to?

Mr. Coombs:—We have had many interesting and valuable papers read at this convention, and this, to my mind, is especially one of the finest. In it he says: "A gas forge or furnace to be a success must also be designed especially for the particular size, kind or class of work desired. So far gas forges are not a success when intended to be used on all sizes and classes of work. Now, in his illustrations from one to five, he did not give us any information as to who designed these furnaces and where plans for their construction may be obtained. What I would like to ask Mr. Stone is, who designed these furnaces? Did he, himself, have to invent or construct these forges for this purpose? I do not know whether the forges have been imported from gas stove firms or whether they were Mr. Stone's invention. Mr. Stone, I think, could give us some information with reference to this matter which would be very satisfactory to us.

Mr. Stone:—In reply to Mr. Coombs, I will say that we make all of our forges ourselves. In those that are illustrated in the paper, the foreman of the forge room and myself got together and he stated about what kind of work he wanted to do and what he expected to do with it, and together we planned and built the forge. We tried it and if it was not a success at that time we studied out where we could make a change and improve it, and we changed it around until we got something that would do the work with the least possible amount of cost as we thought.

Mr. Coombs:—That shows that the gas man has to be in contact with the consumer in helping along the use of gas in the most satisfactory manner.

John R. Lynn:—Apparently there seems to be a very wide difference between the efficiency of gas and coke used for the same purposes. I would like to have that explained. From 500 pounds of crushed coke he has 2,000 forgings and from 1,700 cubic feet of gas he has 2,700 forgings. If the efficiency in the two instances were equal, 500 pounds of coke would be equal to 4,000 cubic feet of gas.

Mr. Stone:—The illustrations as to efficiency were taken from actual practice. Before we went into the business the man wanted to know if we were going to pay him to do it and we weighed the coke that the furnaces used for a given period and made a tabulation of the result obtained. A man loses time when he is working on small forges on a coke fire because he has to fill up his fire once in a while. We had another man keep tab on the men as they filled the fires and waited for them to burn up to a heat sufficient to heat the forges—to a bright fire again—and a man wastes almost a third of his time keeping his fires in trim. This gives an increased number of forgings which a man can make with gas over what can be accomplished with coke. As far as the efficiency of gas and coke is concerned, I cannot attempt to explain it, only possibly there was more heat wasted. The coke fire was open at the top and more heat escaped; while we confined the heat from the gas fire right on the work.

Mr. Andrews:—Mr. President, I move that a vote of thanks be tendered Mr. Stone for his very interesting paper. (Seconded; carried.)

In the absence of Henry L. Doherty, Editor of the "Wrinkle Department," Mr. Butterworth, of Columbus, very kindly consented to read his report:

WRINKLE DEPARTMENT.

HENRY L. DOHERTY, EDITOR.

Mr. President and Members of the Ohio Gas Light Association:

GENTLEMEN:—I believe I was guilty of suggesting that the Ohio Gas Light Association inaugurate a "Wrinkle Department." I did this believing it would add much to the attractiveness of our meetings, and would bring out many wrinkles that never could be secured by the other associations. When I accepted the editorship of this department, I did so believing that I would have ample time to give the matter serious consideration, and as I have heretofore been compelled, more or less, to visit many gas-works, I thought I might be able to pick up some very interesting wrinkles. Shortly after my appointment I unfortunately became so busy with other matters, and have traveled so little of late that I have not been able to give the matter the attention it deserves.

I offer you at this meeting a few wrinkles which I hope may prove of assistance to many of the members, but I am far from satisfied with the effort, and I hope the members will regard it simply as an attempt to establish the department rather than a sample of what may be expected from this department after it is in full running order.

I shall not be able to give this department the attention it deserves, and if some suitable member of the Association will take up this work, I think, with proper enthusiasm and liberal assistance from the other members, it can be made at least as valuable as any other portion of our proceedings. I want to impress on the mind of every member of this Association that he must remember that the editor of the "Wrinkle Department" is simply the editor, and that he must not be expected to first manufacture the wrinkles and then edit them.

I have not had time to solicit wrinkles from the various members of the Association, neither have I had time to look over the wrinkles heretofore published by the other Associations to prevent repetition. Many of the members of the Association know how handicapped I have been for the past year, and if this department fails to meet your expectations, I hope none will jump at the

conclusion that it is impossible for our Association to properly edit a department of this sort.

I wish to acknowledge the help of W. A. Baehr, of Denver, Colo., in assisting the editor.

I. OIL SIGHT FEED.

Author.—Unknown. It has been in use for several years, and I remember seeing it used by James Somerville at Indianapolis, probably as early as 1894.

Purpose.—A cheap and durable sight feed for oil gasified for an enricher for coal-gas.

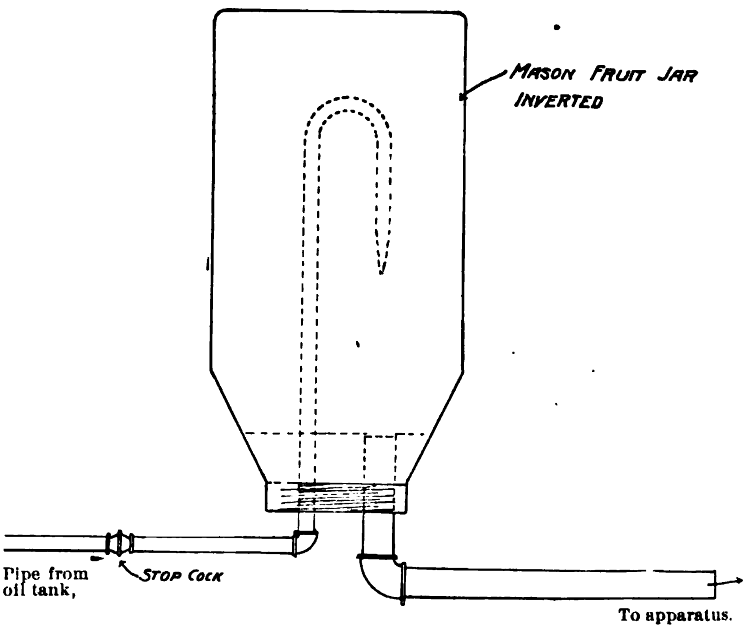


FIG. I. OIL SUPPLY SIGHT FEED.

Description. Fig. I.—It is simply an inverted Mason fruit jar with an inlet and outlet pipe passing through the screw cover, and the inlet bent in the form of a gooseneck, so the operator can tell at a glance whether the oil has ceased to feed or the rate of flow has changed. Glass must be used for sight feeds for all volatile liquids, and it is usually customary to use a glass tube connected at top and bottom to metal pipes. Two connections are

hard to make to glass, and a strain is apt to be introduced which will break the glass before the job is completed, or will subsequently cause the glass to fracture by expansion or contraction of the metal connecting pipes. I have also used instead of the Mason jar a Lungren lamp globe made tight by a seal of mercury contained in an annular cup.

DISCUSSION.

THE PRESIDENT:—Gentlemen, I believe it would be better to discuss the wrinkles separately. I will call on Mr. Somerville to open the discussion on Wrinkle No. I.

MR. SOMERVILLE:—If the members will take a pencil and put a little funnel below the pointed pipe and into the larger one indicated, that will complete the whole design. I see he has left out the funnel. The man who got this up should endeavor to adopt the suggestion of the man who tried it. This is one of the suggestions which came to my notice some years ago and I endeavored to utilize it. The glass broke and I thought a fruit jar would do just as well. I tried the experiment and found that it did just as well.

PRESIDENT WHYSALL:—Has any other gentleman anything to say with reference to this wrinkle? If not we will take another wrinkle, Mr. Butterworth.

II. VAPORIZING OIL.

Author.—The editor. *Purpose.*—A simple and satisfactory means of enriching coal-gas with naphtha, where the make is too small to permit one retort to run continuously on oil.

Description. Fig. II.—The sight feeds are placed permanently in some suitable position, preferably on the wall directly in front of the retort used for oil. One of the upper retorts is used, and the oil feed pipe is suspended permanently above the operating floor and terminates within 10 inches of the side of the mouthpiece with the female portion of a ground joint union. There is a hole large enough to freely admit the male portion of a 1-inch union drilled in the side of the mouthpiece, looking directly into the female portion of this union. A 2-inch wrought-iron pipe of, say, 7 feet, is introduced into the retort, which is fitted on the mouthpiece end with a 2 x 2 x 1-inch tee, with 1-inch outlet at right angles to the 2-inch pipe, and having a 1-inch extension piece of a little less length than the width of the retort. This

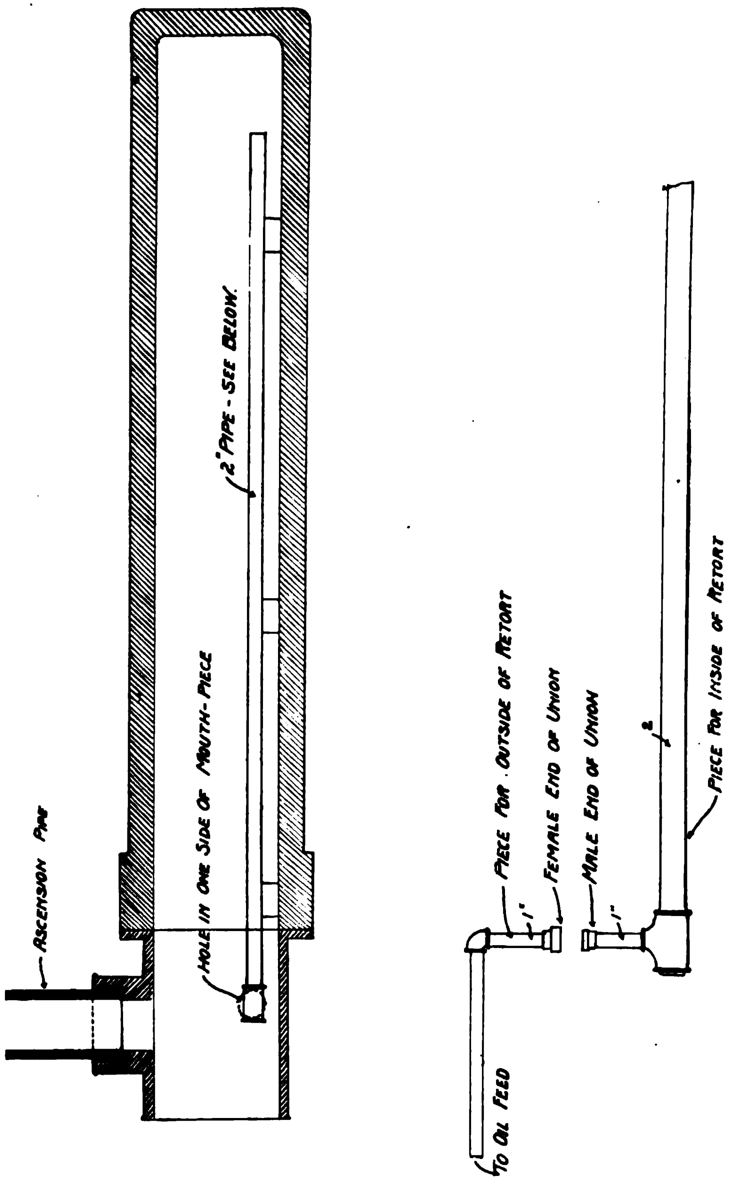


FIG. II. APPARATUS FOR GASIFYING OIL IN RETORTS.

1-inch pipe is passed through the hole in the side of the mouthpiece, and the union screwed together, thus making an oil connection. The hole through which the 1-inch pipe passes is then made tight by luting with mud, and the door of the retort closed and the oil fed in. A few moments only are required to convert the retort for oil-gas making, and it can be run for one, two, four or any other desired number of hours, or may be run several times a day for two or four hours. The 2-inch pipe, which extends to within a foot or two of the end of the retort, has no opening except at the rear end. When the pipe is removed the hole in the mouthpiece is filled with an iron plug and luted with mud. The 2-inch pipe lies flat on the bottom of the retort and is kept sufficiently cool by the incoming oil to last for a long time. The scheme was devised to compensate for the unsatisfactory results obtained by the cartridge system.

DISCUSSION.

Mr. Persons:—At Kansas City, a few years ago—Mr. Chollar was there at the time—an explosion occurred and we devised a scheme for the making of gas without purifying boxes. I think it was along about 1885 or 1886, we made all the gas in Kansas City for two weeks on about this same design except we put it through a funnel. I would much prefer the funnel. Then you can see how much oil you are feeding and be absolutely sure about it.

John R. Lynn:—I would like to ask, Mr. Persons, if you maintained a very high heat on these benches?

Mr. Persons:—We made it intermittently. We would make it a while and then cool a bench and drop it down and go at it again, but if I remember right we had about 96 retorts fitted up. The explosion was on December 17 and on the 24th we had gas throughout the city, and we continued making it in that way until about the middle of January.

III. WATER DISTRIBUTER FOR SCRUBBER.

Author.—The editor. *Purpose.*—A means for obtaining a good distribution of water in tower scrubbers.

Description. Fig. III.—The illustration is taken from our arrangement of this scheme at Denver. Weak liquor is used for washing, and if simply introduced in the ordinary way, will trickle down through the center of the vessel or against its walls. The

introduction of the liquor is simply modified to the extent of allowing the constant supply of liquor to flow into a receiving vessel which, when full, will syphon into the scrubber, causing a momentary flood, which thoroughly saturates the material contained in

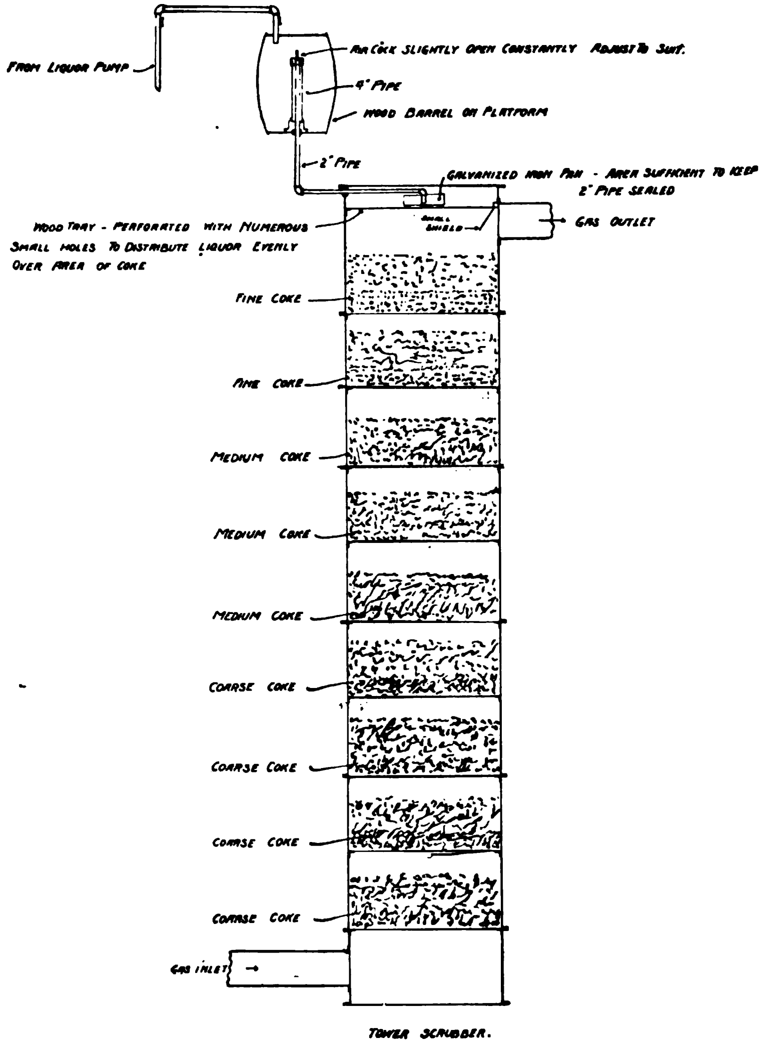


FIG. III. DEVICE FOR DISTRIBUTING WATER IN TOWER SCRUBBER.

the scrubber. Scrubbers equipped as illustrated are in use in Madison and Denver, and are more than ordinarily satisfactory. The Denver scrubber, equipped in this manner, seems to be as efficient as our Standard scrubber.

DISCUSSION.

MR. PRINTZ:—About the same results can be obtained by using a flush tank such as is commonly used in hotels. I know of one in Zanesville that is in use that way and works very satisfactorily.

IV. BY-PASS FOR WINDOW LIGHTING.

Author.—W. H. Anson, Columbus, O.

Purpose.—To permit control of window lights by a night watchman or others without entering the store.

Description.—The supply pipe for the window lights is run adjacent to some accessible part of the window from the outside, and a stop-cock placed in the pipe with an extension stem running through to the outside with a square head to fit on the night watchman's key, and finished off with an ornamental floor plate. This scheme enabled us to obtain a great deal of patronage for window lighting which could not otherwise have been had.

By-pass No. 1 is a simple form, and is older than this Association.

By-pass No. 2 is a modification of No. 1 to compensate for fluctuations in pressure. A Wilder or other suitable form of a volumetric governor burner is inserted on the small by-pass pipe, and at a time of lowest pressure is adjusted to pass just enough gas to maintain the pilot lights. This results in a less consumption, and the objectionable glow of the lights at time of high pressure when they are not in use, and if adjustment is made at time of lowest pressure, they will always light up when the main cock is opened.

By-pass No. 3 is made by using a stop-cock which has a bent handle, which brings the arc of its movement on a vertical plane with the center of the pipe. A hole is tapped in the handle of the cock and a machine screw is inserted which strikes the pipe, and fixes the extent to which the cock may be closed. A by-pass of this sort may be so arranged that the gas may be entirely shut off by throwing the lever handle of the cock toward the head of the

screw, and when thrown toward the point of the screw the cock will have sufficient opening to maintain a light in the lamps. The screw permits a very delicate adjustment.

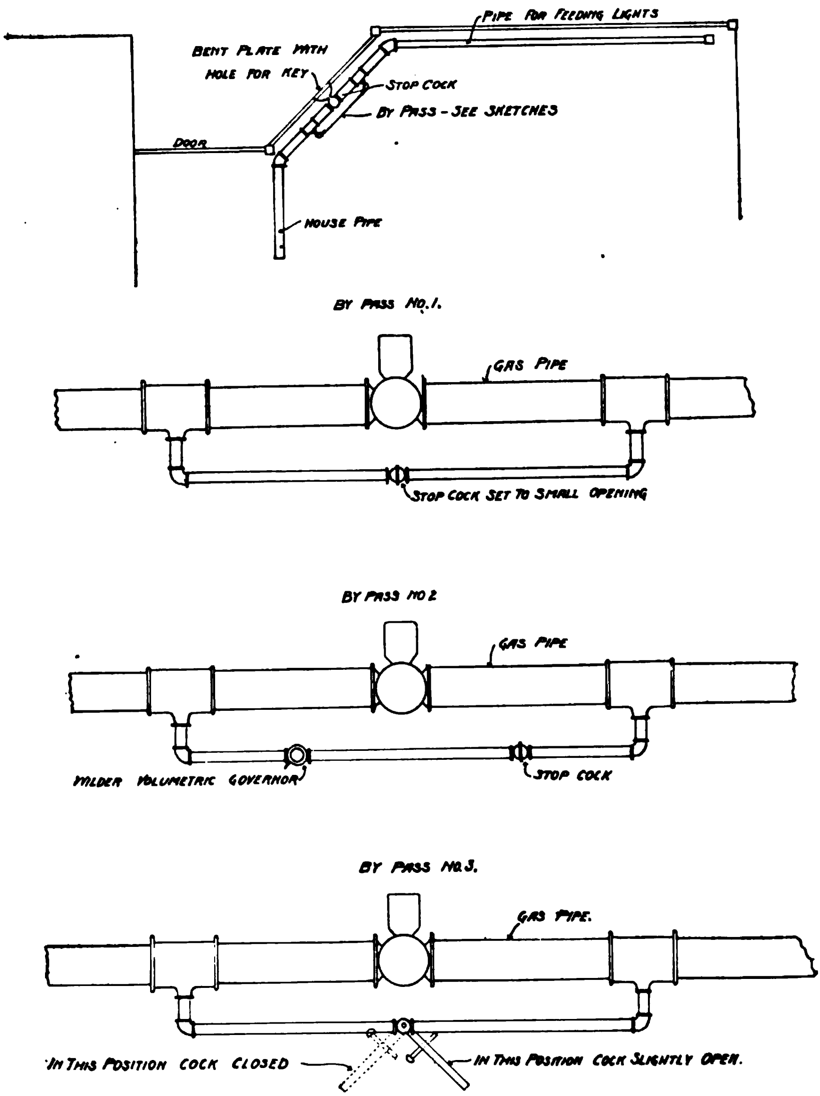


FIG. IV. BY-PASS FOR WINDOW LIGHTING.

Maintaining Welsbach lights with just sufficient gas to keep them lighted can be done satisfactorily under very unfavorable conditions if the matter is given proper attention. I know of no simple way, however, to get satisfactory results where lights are on different levels, except by piping all lights on different levels with separate pipes.

DISCUSSION.

MR. PERKINS:—My experience, Mr. President, has been very limited along this line. We have a few cases in our place where the watchman turns the gas out and it is lighted by an electric spark. We do not use by-pass burners at all, but we have an arrangement very similar to the device which Mr. Doherty speaks of, so that the watchman can turn it off with a key from the outside.

V. COKE CRUSHER.

Author.—The editor. *Purpose.*—To reduce the number of times coke must be handled to be crushed.

Description.—The crusher is an ordinary one as made by C. M. Kellar, of Columbus, Ind., but is mounted on an extension bed

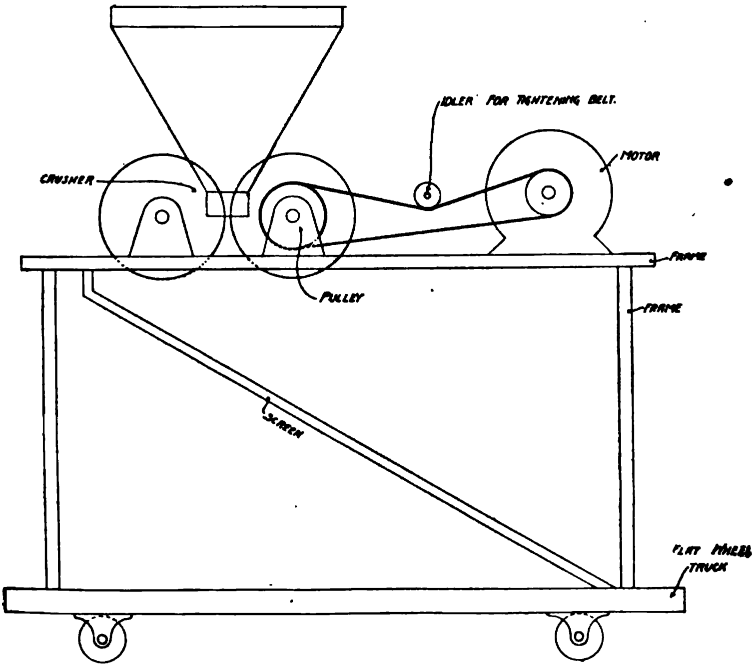


FIG. V. COKE CRUSHER WITH MOTOR ATTACHMENT.

frame of sufficient size to contain a 5-horse-power motor, and the whole mounted on flat truck wheels. This enables the crusher to be taken to the coke instead of taking the coke to the crusher. It will also permit the crusher to be operated along the edge of a long coke pile, or it can be made to "back up" and eats its way into the coke pile, always permitting the crusher to be within easy forking distance of the coke. At the same cost for crushing, it is always desirable to crush the coke which has been stocked the longest or handled most. The coke is finer and less desirable for coarse coke, and after being crushed it loses its weather-beaten appearance, owing to the numerous new fractures. We have used this arrangement at Madison for three or four years, and believe that it has saved us much money.

A gas engine might be used instead of a motor, and gas supplied by a flexible tube, but the engine would have to be of considerably greater capacity or else have a great flywheel weight, as we find that our 5-horse-power motor must be fused to 20 horse power. The total work, however, with two men feeding coke is less than 5 horse-power on an average, but so intermittent that at times it is nearly four times the rating of the motor.

VI. SEAL POT ON MAIN.

Author.—Unknown. *Purpose.*—Automatic discharge of condensation from main pipes. *Explanation.*—At the last meeting of the Western Gas Association the gooseneck drip was shown. I did not know that this drip was now used, as in case of heavy pressure the seal is blown out and it cannot reseal itself. I consider its use as highly dangerous, and offer another form of automatic drip which I consider preferable.

Description.—The lower part of the main is tapped on the bottom and a small pipe inserted which dips into a seal pot from which there is a fixed overflow. In case of excessive pressure, the gas will escape but does not permanently destroy the seal. There is also so much water present that a much greater time is required to unseal by evaporation. Emerson McMillin, while Superintendent of the Columbus Gas Works, equipped that plant with these seal-pot drips, superseding the gooseneck type in 1883, and as far as I know he is the father of this wrinkle.

DISCUSSION.

MR. CHOLLAR:—I suppose that kind of drip would work all right, but I don't think I should care to have it. I would prefer to put in a regular solid tight seal. I have used something similar

to that and I have used a syphon. I remember one case years ago where the syphon got out of seal and I expect it blew for three or four years, for all I know, before it was discovered.

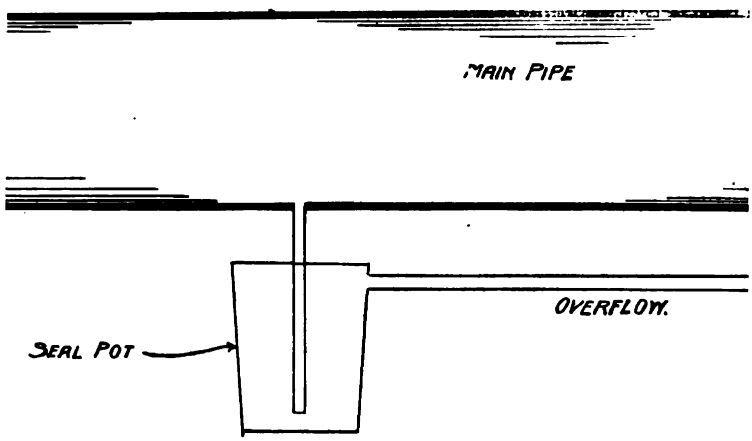


FIG. VI. SEAL POT ON GAS MAIN.

MR. BUTTERWORTH:—In our works in Columbus we use this sort of seal pot. The top is made absolutely gas-tight, through which this drain pipe enters, and the overflow pipe is conducted into a common pipe that is brought up through the cellar of the building and through the wall where it would be observed if any of the seal pots should be blowing. This would seem to remove Mr. Chollar's objection wholly.

JOHN R. LYNN:—I should think in anything of that sort it would be a good place to put a stop-cock.

THE PRESIDENT:—I have had some experience with a similar drip pot, and found if it ever did break seal it would keep on blowing and take all the fluid out.

MR. BUTTERWORTH:—The advantage of the system we have in use is this, among others, that in no event can gas escape into the cellar of your buildings and from the cellar find its way into the house above. The escaping gas is always conducted outdoors.

THE PRESIDENT:—It is not intended for street mains at all.

MR. BUTTERWORTH:—It can be used for that purpose. By making this a double seal pot, by putting in a second one in order to make assurance doubly sure, it would be a very effective and cheap seal pot for street use.

VII. PRESSURE GAGE.

Author.—The editor designed this and several other gages for very sensitive measurements of gas pressures, but has since discovered that a similar gage to this has been used for many years for measuring chimney drafts.

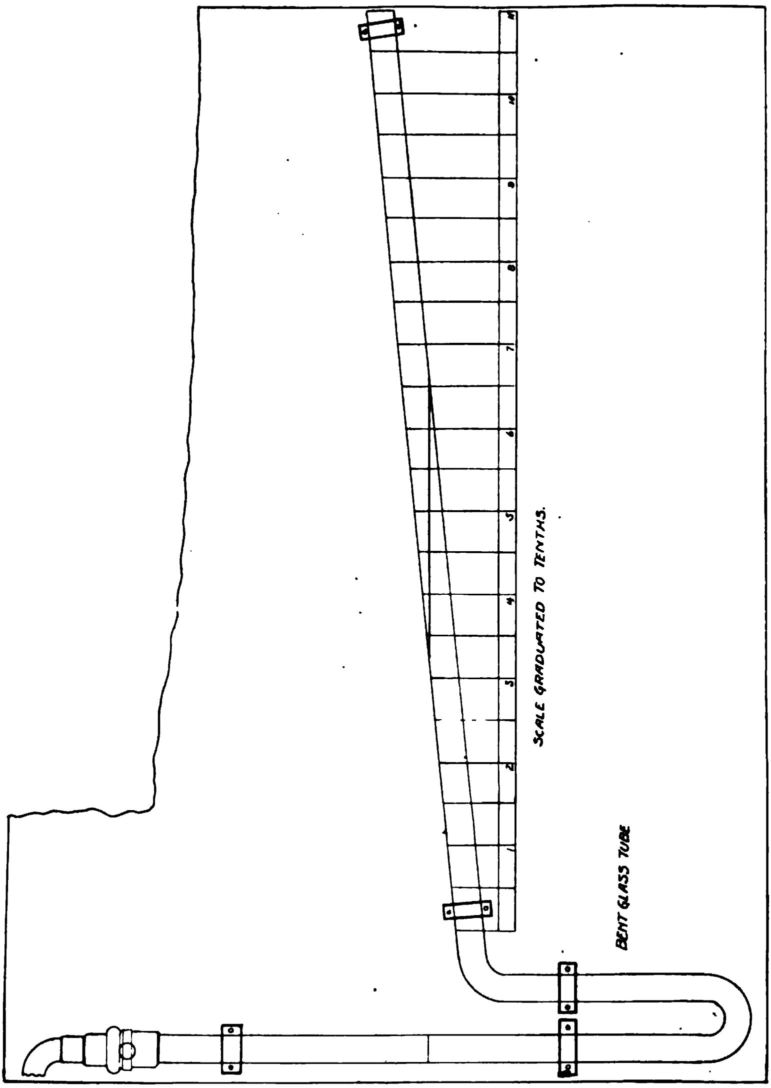


FIG. VII. PRESSURE GAGE FOR READING SMALL DIVISIONS.

Description.—The gage is simply a modification of the ordinary U gage with one leg carried out at a very slight angle from the horizontal. The reading of the gage may be laid off on the horizontal travel and 0.1-inch pressure may be made to have a travel of an inch or more and thus permit very accurate readings.

DISCUSSION.

MR. ANDREWS:—This seems to be to be quite a good wrinkle, as it is rather difficult to read the gage of the ordinary type closer than 0.1 inch, and where you measure drafts you want to get a great deal closer than that, if your results amount to anything.

MR. CHOLLAR:—An apparatus like that is on the market. You can buy it—I don't know exactly where—but you can read within 0.01 inch with it very nicely. I think it is made by Queen & Co., of Philadelphia. They use them more for chimney drafts than for gas drafts. They work very successfully.

VIII. DUPLICATING PEN.

Author.—H. M. Long, South Bend, Ind.

Purpose.—To duplicate record on coupon of bill without actually rewriting it.

Description.—On the extremities of a bar with a length equal to the distance between the statement column on the main bill to the statement column on the coupon are mounted two ordinary pens. In putting down the meter statement and consumption, the penholder is so tilted that only the left-hand pen is in contact with the paper, but when the extensions are made both pens are in contact with the paper, and figures on the main bill are duplicated on the coupon with the labor of writing it but once.

DISCUSSION.

CHARLES S. RITTER:—I have nothing particular to say about it, except I think it would be very hard to use. I have something to recommend instead, though, and that is rubber stamps. We have been using rubber stamps for some time and by actual count I find a saving of from 50 to 75 per cent. in time in making out gas bills. The amount of gas consumed is on the top of the stamp, and used as an index, and the gross amount, discount and net amount at the bottom of the stamp, so that when you get your consumption you can immediately reach for the proper stamp and

use it. We have a set of stamps running from 10 cents to $10 which occupy a space about 12 inches square. It is considerably more convenient, I think, and more rapidly used than the device referred to by Mr. Doherty.

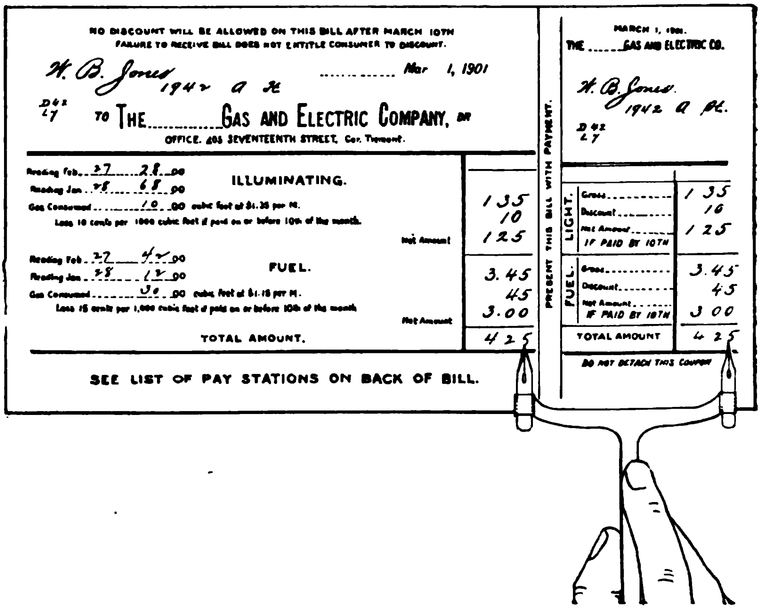


FIG. VIII. PEN FOR DUPLICATE RECORDS.

MR. BUTTERWORTH :—The stamp system that Mr. Ritter speaks about is a very good one,I think. It saves a lot of time. You cannot makes mistakes with it and your figures are legible.

GENERAL HARBISON :—How does it affect your office help?

MR. BUTTERWORTH :—It reduces the office help. It is absolutely accurate. You can hardly make a mistake with it. It is very rapid and satisfactory, indeed.

GENERAL HARBISON :—Does it require a $2,000 man to operate it when a couple of good-looking young ladies at $500 or $600 a year can do it the other way just as well?

MR. BUTTERWORTH :—We have found the use of stamps for this work to be eminently satisfactory.

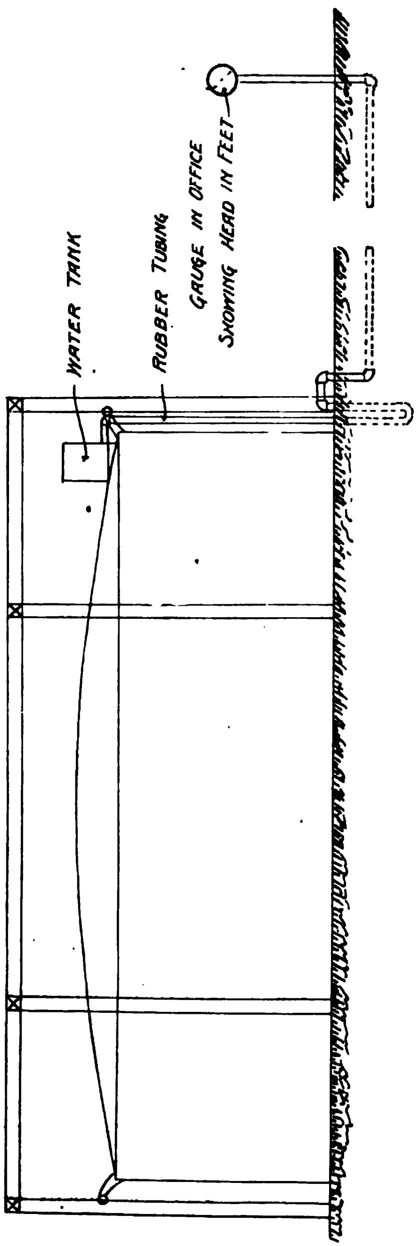


FIG. IX. DEVICE FOR SHOWING HEIGHT OF GAS HOLDER.

IX. HEIGHT OF GAS HOLDER.

Author.—R. J. Chambers, Montgomery, Ala.

Purpose.—To be able to indicate the height of gas holder at a point from where it cannot be seen.

Description.—A tank of water is placed on the holder and connected by flexible tubing and iron pipe at some other point to an ordinary steam gage, which has previously been experimentally calibrated into direct readings of the height for the holder. A recording Bristol steam gage could be used if desired and a permanent record obtained.

X. PORTABLE TELEPHONE.

Author.—B. W. Perkins, South Bend, Ind.

Purpose.—To economize the number of telephones used, or to enable it to be moved to such place as will enable it to be answered conveniently.

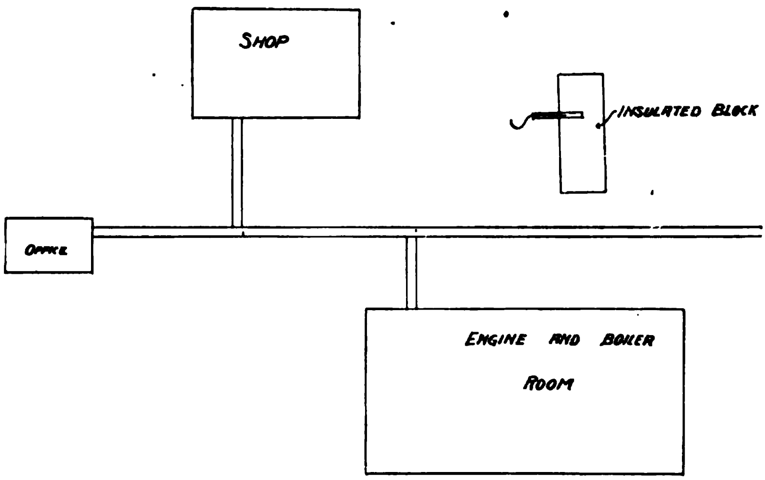


FIG. X. PORTABLE TELEPHONE ARRANGEMENT.

Description.—An ordinary telephone of the "wall-set" type may be used. The instrument circuit ends in two hook-eye terminals mounted on an insulated block (dry wood will suffice). Parallel terminals are placed wherever it is desired to use the telephone, and these terminals end in two hooks equi-distant to the hook-eyes on the instruments. The instrument is then hung on

whichever set of hooks are most conveniently located for answering the telephone. The weight of the instrument is enough to insure sufficient contact.

DISCUSSION.

Mr. Perkins:—The description I should think would be sufficiently explanatory of this wrinkle. It was devised in our case because our office is located at the works, and as that is locked up, of course, at 6 o'clock, we wanted the telephone for the balance of the night in another part of the works. This is the only way we could do it without having to pay for another telephone. We also use it in the shop adjacent.

XI. METER TESTING CONNECTION.

Author.—Unknown. *Purpose.*—To lessen work in testing meters.

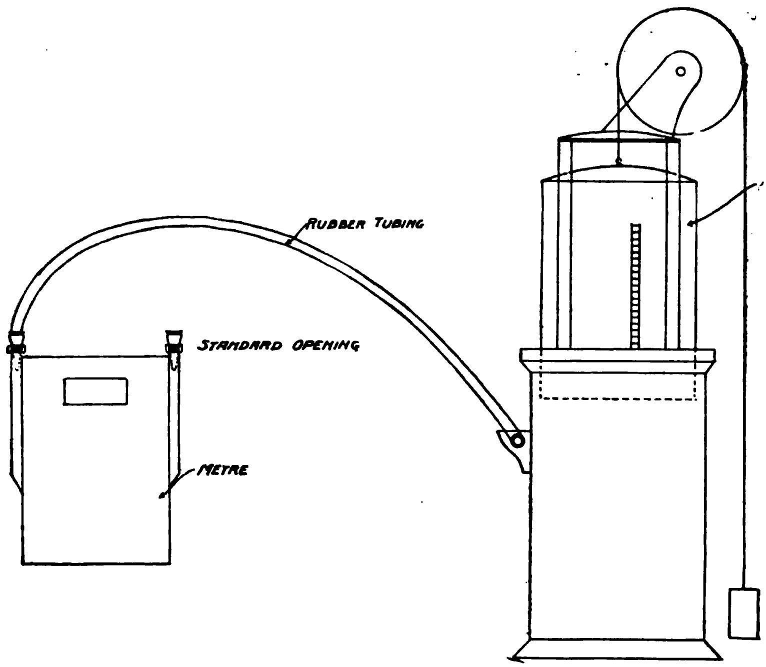


FIG. XI. DEVICE FOR RAPID ATTACHMENT OF METER WHILE TESTING.

Description.—Instead of using the usual thread connection, a spigot shaped metal connection is provided, which slips into the inlet and outlet of the meter and is made tight by a roll of putty. I first saw this wrinkle in use at Syracuse, when that plant was in charge of Mr. Littlehales.

DISCUSSION.

Mr. Olds:—I do not quite understand how much time you gain when you stop to put the putty in.

Mr. Persons:—I was going to say, Mr. President, that I should doubt the practicability or the quickness of it, as it is not used in any meter shop that I know of. They simply use a lever on the nut and throw it by hand quickly.

Mr. Lynn:—It might not take much muscular action, but I think it would consume more time. I saw a very good device for testing meters in Milwaukee. The man using it has a platform that he puts his meters on, which works with a lever from the floor and a man steps on it—the two connections are stationary—he has a long bar that he can adjust for any connection or any size meter. He gets the meter on his platform and simply steps on his lever and brings the lever up tight. There is a rubber joint so that you can brace it up as tight as you wish. It is all done in a second. This lever is on a ratchet so that when you want to release it, all you have to do is to kick it off and a spring releases it and the meter drops down and is pulled away. This is one of the nicest devices of the kind I have seen.

XII. PREVENTING ASCENSION PIPE STOPPAGE.

Author.—The editor. *Purpose.*—To prevent stopping standpipes by cooling them by the injection of a small amount of water.

Description.—We were once troubled with stopped standpipes at Madison, which none of the usual remedies seemed to cure. The congestion in the standpipe seemed to be a semi-pitch, too soft for easy cleaning and too hard to flow. Lowering heats and firing green coal or even slack saturated with light tar in the mouthpiece did not relieve our trouble. We then equipped the lids of our ascension pipes with the device illustrated, to enable water to be dripped into the standpipe to either condense enough of the lighter tars to soften the deposit which was forming or to cool it to a degree of brittleness, which would enable its more easy removal. The scheme proved more effective than any other remedy

we had tried, but was not entirely successful. It seemed to harden the deposit which formed in the top of the standpipe, and soften the deposit in the lower end of the standpipe. Before we completed our experiments, we changed our coal and the trouble disappeared. No bad results occurred from the use of water in the standpipes.

DISCUSSION.

MR. SOMERVILLE:—I have nothing to say about this. I suppose the idea is to keep the standpipe cool, and this seems to be a good method of doing it. He says that he changed his coal and that then the trouble disappeared. That is often the case I find.

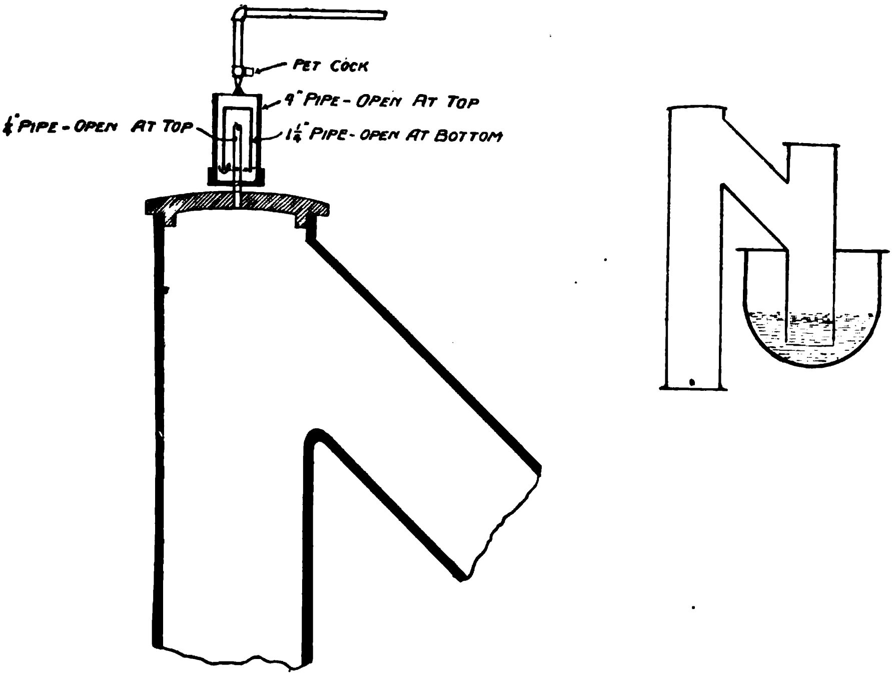


FIG. XII. WATER SPRAY FOR PREVENTING ASCENSION PIPE STOPPAGE.

MR. COOMBS:—Some years ago we had trouble with standpipes which occurred from high heat. Of course, we know that to get the best results from a retort, we have to maintain high heat. Whenever we run at low heat we have no trouble whatever with stopped pipes, but our yield was low, probably 4 feet per

pound. Increasing the heat for the purpose of increasing the yield per pound to 4.75 to 5 feet, we found we were troubled with a stopped standpipe. I found that as long as our pipe was cool we had no trouble. The low heats on the retorts gave us a low temperature at the standpipe. I thought at that time if we could keep up the high heat and decrease the standpipe's temperature, probably we would have less trouble with our pipe. I thought at that time if we could construct a water jacket around the outside of the standpipe, and maintain a continuous stream of water through the standpipe, we might be able to decrease the trouble. We did that, kept up the heats in the retorts and decreased the temperature of the standpipe and found that our trouble disappeared. While the trouble was obviated in that way, it seemed to be a difficult matter to construct the double standpipes. I took about three benches of 3's at that time and we had satisfactory results except the matter of construction. It is a little expensive and a good deal of trouble to do it. I then tried another experiment and invented a reservoir over the top of the mouthpiece on a bench of 5's. We introduced the water on the top and let it run down from the top through the two middles and down to the bottom. We found that answered the same purpose as a double standpipe. With that kind of appartus we found we could run the high heats and prevent the trouble of a stopped standpipe, that is, with a 6-inch pipe. The larger the standpipe we have, of course, the less trouble we have with stoppage. We have found if you want to carry high heats—very high heats—you can prevent this trouble by a double pipe or a jacketed standpipe or a reservoir on each mouthpiece. All you have to do is to keep your standpipes cool and your trouble is prevented.

President Whysall:—I have used a perforated diaphragm in the mouth of the retort—rather at the rear of the mouthpiece—and have good results from it.

XIII. SEAL STOP-COCK.

Author.—The editor. *Purpose.*—Simple and absolutely tight stop-cock, and one which can be used on crude gas or gases destructive to ordinary cocks.

Description.—The cut clearly shows the arrangement of piping. It can be made up as shown, or with two tees connected with a close nipple. A small tin pail or any other suitable vessel filled

with water can be used as a seal. This cock is particularly applicable for laboratory work, and especially where destructive gases are being handled. Its use, however, is limited to low pressures that can be easily overcome by a reasonable depth of seal.

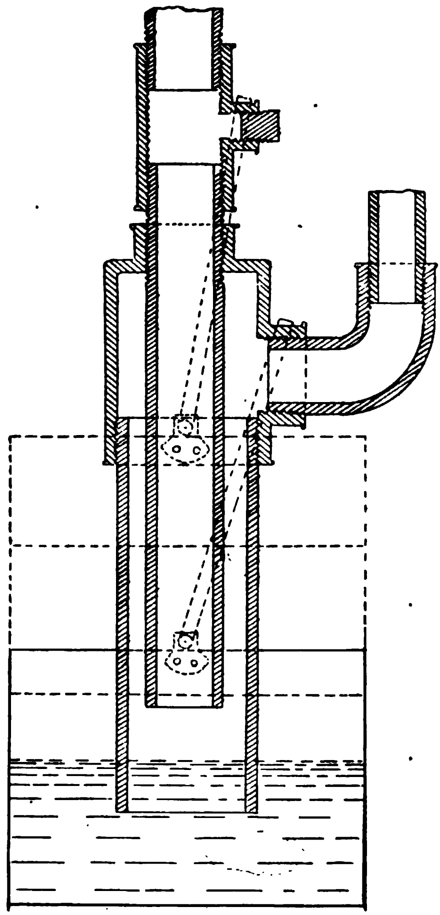


FIG. XIII. SEAL STOP-COCK.

XIV. ELECTROLYSIS IN GAS MAINS.

Author.—Unknown. Brought to the attention of the editor by Henry I. Lea, Evanston, Ill.

Purpose.—To determine the presence of electrolytic action on mains without uncovering them.

Description.—A hole is dry-tapped into the main and a plug inserted. To this plug is soldered a suitable flexible conductor

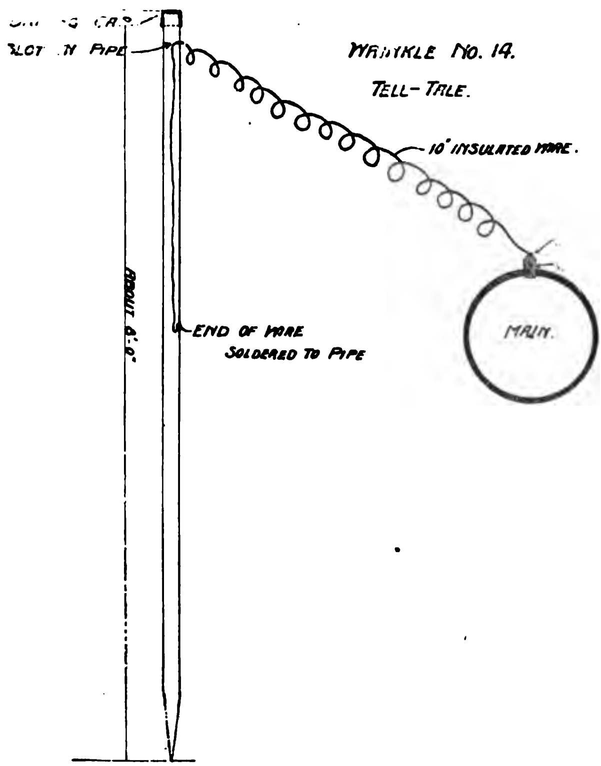


FIG. XIV. APPARATUS FOR DETERMINING PRESENCE OF ELECTROLYTIC ACTION IN GAS MAINS.

which is also connected to an iron bar which is driven in the ground alongside of the main. By pulling up the bar at stated periods, it is believed that if the main is affected the bar will show it. I am a bit skeptical about the efficacy of this method, as the bar will not necessarily show any effect, even though the main

may be badly eaten. If this method is used, great care must be taken to insure good electrical contacts to all connections. The hole in the main should be dry-tapped, as a film of oil is a perfect insulator. The other connection must be made mechanically strong and then soldered.

Mr. Lea also sent me a wrinkle used at Du Quoin, Ill., but failed to send a description which would enable it to be illustrated. It is an arrangement of a furnace chute for coke to be run back and forth on a trolley.

Mr. Persons:—I move that a vote of thanks be extended to the editor of the "Wrinkle Department," Mr. Henry L. Doherty, for the very interesting and valuable suggestions presented. (Seconded; carried.)

Resolution of Sympathy.

Mr. Butterworth:—At some point in these proceedings I want to introduce a resolution, and, if you will permit me, I will do so at this time. It is a short one. We all know Mr. A. C. Humphreys, who is an honorary member of this Association, and in honoring him we but honored ourselves in making him such. He has attended our meetings and participated in our deliberations. We appreciate very much his kindly interest in this Association. We know also that he has recently met with a most severe loss in the death of his two sons by drowning in the Nile River. I would like to offer this resolution, Mr. President, if you please:

"*Resolved,* That the Secretary of this Association be and he hereby is directed to transmit to our honorary member, A. C. Humphreys, of New York, our deepest sympathy in the great affliction that has recently befallen him in the tragic and untimely death of his two sons." (Motion seconded; carried by a standing vote.)

QUESTION BOX.

President Whysall:—Question 9—"What is the best manner of making service connections with a 2-inch street main?"

General Harbison:—The best way to do that is not to have any 2-inch mains, and if there are any, to remove them and use them for service pipes and lay a larger main. That is the proper way to do it, sir. Our experience is that we cannot afford to lay a 3-inch main, and miles of 3-inch mains we have removed from the streets that have been asphalted during the past five or six

years in our city we are now using for service pipes. We have tried to save every lineal foot of it with the least possible wastage, and I think we have not 1,500 feet in our pipe yard to-day. It has been used for service pipe, using a 3-inch cast-iron pipe, instead of a 2-inch wrought-iron pipe, which can be done without increasing the cost to the owner of the property.

JAMES T. LYNN:—I rise to a question of order. There are hundreds of companies in Ohio, and thousands of them in the United States and in Europe, I suppose, which use a 2-inch main. Smaller companies which have not quite as much money as General Harbison's company, and are not quite so ably managed, have to use some 2-inch mains. The question which we are discussing is the best manner of making service connections with a 2-inch street main, and not whether a 2-inch should or should not be laid.

MR. MAXON:—I have had some experience in tapping 2-inch mains, having been connected with one of those smaller companies which Mr. Lynn says do not have so much money. We have used a split sleeve for that purpose very sucessfully, and in that way we find it possible to tap the main without weakening it too much. That is the best device we have been able to run across—a split sleeve, deep threaded.

JAMES T. LYNN:—I have tapped a few 2-inch cast-iron mains, Mr. President, and I have always drilled a hole and tapped it just the same as any other size main—that is where the service was less than an inch. If it is larger than that, I think it would be advisable to put on a split sleeve or something of that kind, but in the case of a wrought-iron pipe, we did our tapping with a diamond point, cutting out a hoie and then threading, which gives us a little more surface for the thread than it does to drill it out. It does not cut away the iron so much. If I had a 1-inch or a 1.25-inch pipe, then I would put a split sleeve on it.

GENERAL HARBISON:—How large have you been able to tap in without the use of a sleeve?

MR. LYNN:—Three-quarter inch.

GENERAL HARBISON:—Into a 2-inch main?

MR. LYNN:—Yes, sir.

GENERAL HARBISON:—Driving a pneumatic buggy tire over it would be apt to break the main, I should think.

JAMES T. LYNN:—Well, I have tapped a good many hundreds of them, and if I wanted an inch service in a house—we don't run less than an inch—I would make my tap 0.75 and put in a short nipple. I have done that often with a 2-inch main.

Mr. Maxon :—I have always thought it rather weakened the pipe and that it was preferable to use a sleeve. I have made a great many more taps by the method which Mr. Lynn suggests than I have by means of a sleeve. However, lately I have been using the sleeve altogether.

The President :—I would like to know if you have had any trouble with them.

Mr. Maxon :—I have in a few cases where the mains were shallow.

John R. Lynn :—You have mains break where there are no taps at all in a few cases. I am fortunate enough to have some 2-inch cast-iron mains, and I do not put anything smaller in than a 1.25-inch service, but I keep a lot of special service ells with a 0.75-inch male and a 1.25-inch female end, using a 0.75-inch tap in the main.

Mr. Coombs :—We have no 2-inch cast-iron pipe, but we have some 2-inch wrought-iron pipe, and if we have to exceed a 0.75-inch service we cut our line in two and place in a tee for a 1-inch or a 1.25-inch service. A 2-inch wrought-iron pipe will take care of a 0.5-inch tap, but over and above a 0.5-inch tap on a 2-inch line, I should think it too much altogether. I don't think a satisfactory connection can be made with a 2-inch line by a tap more than 0.5-inch, but if you tap a 0.5-inch it will be all right.

President Whysall :—Question 16—"Where is the best position for an exhauster?" I will call on Mr. Andrews.

Mr. Andrews :—Some of the members had a discussion last night on that point, and it was contended that the exhauster should follow the P. & A. tar extractor, if you had such an apparatus in use in the works. On account of the fact of drawing the gas through the exhauster, you get a better impinging effect on the different plates than you would if you forced it through.

Mr. Schwarm :—In our works we placed the exhauster between the hydraulic main and the P. & A. extractor. We carry our gas around overhead, through a 12-inch main, and to the exhauster. Before it gets to the P. & A. extractor, it is almost free from tar, so that there is very little tar taken out afterwards. We force the gas through the P. & A. extractor, instead of drawing is through.

The President :—In order to answer this question, I will ask you why you placed it there.

Mr. Schwarm:—I do not know why it was placed there. It was placed in the works when it was built, long before I took charge, but I merely cited the fact that it works equally well. When you have any connection with your tar extractor and overhead pipe, which contains a large amount of tar before it reaches the tar extractor, by the time it gets there, it is almost clean.

Mr. Coombs:—I believe the position to place an exhauster in is between the retorts and your first condenser. One reason is to have the exhauster under the control of the retort man and right next to the retort house. That is one good reason. It works just as well after it leaves the retort house to have it in close contact there.

John R. Lynn:—It is not absolutely necessary to condense your gas before you get to the exhauster. A little warm tar is not going to hurt the exhauster. It will be a good thing for it.

The President:—What shall we do in regard to an executive session? Is it the desire of the members that we hold an executive session this afternoon?

Mr. Hayward:—For the purpose of bringing it before this meeting, I will move that we now go into executive session. (Seconded; carried.)

EXECUTIVE SESSION.

Mr. Persons:—Mr. President, I have in writing here a proposition which I desire to submit to the Executive Committee. It is as follows: "We, the undersigned members of the Ohio Gas Light Association, hereby offer to the Executive Committee a proposition to amend Rule 10, page 5, of the Constitution, so as to read that the annual dues shall be $4 per year, instead of $3, as at present.

F. R. Persons,
B. E. Chollar,
J. T. Lynn,
C. W. Andrews,
T. C. Jones."

The President:—The communication will be filed and submitted to the Executive Committee. Under the Constitution and By-Laws of the Association it will have to go over until our next regular meeting.

QUESTION BOX.

Full discussion was then had on Question 13—"What is the future of the vapor light for store lighting?"

In this connection the subject of the course pursued by the Welsbach company in the use of Welsbach burners on lamps other than gas lamps was also fully discussed.

Mr, Schwarm then submitted the following motion: I move that the Executive Committee of this Association be instructed to confer with the insurance underwriters of this state and secure all the available statistics on the subject of the rates on buildings lighted by gasoline, electricity and gas, and to make comparison along these lines, and after a thorough investigation of the subject, they furnish such information as they are able to obtain to the gas companies throughout the state; and to get the law now in force on this subject couched in good, plain English so that we may spread it broadcast among our customers. (Motion seconded; carried.)

Mr. Butterworth:—I now move, Mr. President, that we resume our regular, open session. (Seconded; carried.)

OPEN SESSION.

Irving Butterworth then read the following

REPORT OF NOMINATING COMMITTEE.

To the Members, the Ohio Gas Light Association:

Gentlemen:—Your Nominating Committee begs leave to report the following names as officers of this Association during the ensuing year:

President, Henry L. Doherty, of Columbus, O.; Madison, Wis.; New York City, N. Y.; Denver, Colo., etc.

Vice-President, C. W. Andrews, Hamilton, O.

Secretary and Treasurer, T. C. Jones, Delaware, O.

Members of the Executive Committee, F. W. Stone, Ashtabula. O., and Fred R. Persons, Toledo. O.

Editor "Wrinkle Department," E. E. Eysenbach, Columbus, O.

Editor Novelty Advertising Department, B. W. Perkins, South Bend, Ind.

Respectfully submitted,

Irvin Butterworth,
L. W. Wells,
Charles H. Printz,
Committee.

ELECTION OF OFFICERS.

JAMES T. LYNN:—I move that the report of the committee be received and adopted, and also move that the President be authorized to cast the ballot of the Association for the election to office of the members therein mentioned. (Seconded; carried unanimously.)

PRESIDENT WHYSALL:—Gentlemen, I have great pleasure in casting the ballot of the Association for Henry L. Doherty as President for the ensuing year, C. W. Andrews as Vice-President, T. C. Jones as Secretary and Treasurer, F. W. Stone and Fred R. Persons as members of the Executive Committee, E. E. Eysenbach as editor of the "Wrinkle Department," and B. W. Perkins as editor of the Novelty Advertising Department.

The officers above nominated were then duly declared elected.

C. W. Andrews, the newly elected Vice-President, being called on for remarks, said: "Gentlemen, I wish to assure you that I very highly appreciate this honor, which is not deserved on my part, as I am a young member of the Association. But at the same time I will use my best endeavors to push forward the work of the association as begun in the past, and which we hope to continue in the future. I thank you."

The Secretary said: Mr. President and gentlemen, I thank you very much for this renewal of confidence. If I have done anything to make this meeting profitable it has been a pleasure. I have a large, warm spot in my heart for the Ohio Gas Light Association, and I assure you that I will always do anything I can for its interests. I thank you.

[The following extract is taken from a letter received by the Secretary from Mr. Doherty several days after the meeting:

"I sincerely appreciate the honor done me by the members of the Ohio Gas Light Association, in electing me their President for the coming year. It is needless to say that I shall do everything in my power to make the next meeting of our Association a pronounced success."]

THE PRESIDENT:—Any further business before the Association?

MR. ANDREWS:—I move a vote of thanks be tendered the committee which has had in charge our entertainment while guests of the city of Dayton. I also move that a vote of thanks be tend-

ered to the officers of the Association for the efficient work in carrying this our seventeenth annual meeting to so successful a conclusion.

Mr. Butterworth seconded the motion, which was unanimously adopted.

Mr. Schwarm:—I move we tender a vote of thanks to the Dayton Gas Light and Coke Company, the Dayton Gas and Fuel Company and the Gem City Stove Works for their profitable entertainment during our sojourn in Dayton, also to the National Cash Register Company for its generous donation of this hall for our meeting. (Seconded and carried by a rising vote.)

General Harbison:—I apprehend a motion to adjourn will come very soon. Before you do it I will ask you to pardon me just a moment. I want to thank the Ohio Association and every individual member for the courtesy, kindness and loving affection with which I have been greeted and treated since I came here. I have traveled from my home here to meet the brothers in anything but a good state of health. I believe I have been benefited very much by being here. I wish that I could see you brothers occasionally at my own home. It would do me a lot of good and it will not hurt you. If you come into New England, do not fail to let me know as to where you are and let me have a greeting. These gatherings are of much benefit to us and to me, as I speak from experience. I have occupied a great deal more of your time and patience than I had the slightest idea I would do when I came here, for I expected to listen and to receive your cordial greetings and did not expect to be called upon to say anything. But I am constructed on the model, Mr. Chairman, that when anything comes up that interests me or I think will interest my associates in business, to discuss it in all its phases, not for the sake of being heard, but for the sake of possibly giving a suggestion, or from what I might say bringing out a suggestion from somebody else who knows more about it, that may be of practical value to us in our calling. Mr. President and members, I thank you.

Mr. Butterworth:—Mr. President, if you will permit me, I think I express the feelings of every member when I say we are very glad to have General Harbison with us. We appreciate the compliment he has shown us by coming such a distance to be present at this meeting. We are all pleased to hear what he has said and we have derived benefit from his remarks and advice which, as he admits, he gives so freely and so well.

THE PRESIDENT:—I think it is the unanimous opinion of every member of this Association, that we have all received benefit from the suggestions which General Harbison has given us, and on behalf of the Association I take pleasure in returning the thanks of the Association for the compliment shown us by him in being with us at this meeting.

MR. PERSONS:—If there is no other business before the Association, I move that we now adjourn a very profitable and pleasant meeting. (Motion seconded.)

THE PRESIDENT:—Before putting the motion, I wish to say that I have enjoyed it very much myself. I think the Association is to be congratulated on the hearty co-operation of all its members who have worked together to make this a most successful meeting. There has been no hanging back, and as far as I can see, it has been a most profitable and pleasant meeting.

MR. BUTTERWORTH:—Mr. President, I agree with you. I think I have attended every meeting of the Ohio Association from start to finish, and this, I think, is one of the best meetings we have ever had, which is saying a great deal.

The motion, being duly seconded and carried, the seventeenth annual meeting of the Ohio Gas Light Association then adjourned.

Henry L. Doherty

PROCEEDINGS

OF THE

Ohio Gas Light Association

Eighteenth Annual Meeting

HELD AT

THE GREAT SOUTHERN HOTEL,
COLUMBUS, OHIO.

March 19th and 20th, 1902.

PUBLISHED BY THE ASSOCIATION.
EDITED BY THE SECRETARY

EIGHTEENTH ANNUAL MEETING

OF THE

Ohio Gas Light Association

HELD

MARCH 19th and 20th, 1902.

PROCEEDINGS.

FIRST DAY.—MORNING SESSION.

At 10 o'sclock A. M. the Association was called to order by the President, Mr. Henry L. Doherty.

Upon roll call the following members reported their attendance:

E. D. ABBOTT,
C. W. ANDREWS,
CHESTER L. ARTHUR,
GEORGE W. BARNES,
ISAAC C. BAXTER,
FRANK L. BEAM,
W. E. BENDER,
A. C. BLINN,
STANHOPE BOAL,
MILLER BOOTH,
JOHN P. CANTERBURY,
H. A. CARPENTER,
G. N. CLAPP,
W. F. CLANSEN,
J. W. R. CLINE,
J. S. CONNELLY,
MOSES COOMBS,
FRED. S. COOMBS,
F. G. CORBUS,
ALFRED D. CRESSLER,
GEORGE DAUGHERTY,
JOHN DELL,
R. R. DICKEY,
HENRY L. DOHERTY,
S. MILO DOLE,
G. L. DROUILLARD,
JAMES W. DUNBAR,
ALFRED B. EATON,
ERNEST E. EYSENBACH,
JOHN FRANKLIN,
FRANK H. FIELD,
W. H. GARDNER,
F. L. GARRISON,
A. L. GASSETT,
JOHN M. GREGORY,
O. N. GULDLIN,
J. W. GWYNN,
L. C. HAMLICK,

J. H. Harbine,
H. D. Harper,
J. A. Harris,
J. S. Hedges,
Frank H. Hess,
A. G. Holmes,
E. D. Johnson,
John O. Johnston,
Howard Jones,
T. C. Jones.
Lazard Kahn,
Wm. H. Knight,
Hugh McK. Landon,
Alanson P. Lathrop,
Nathan G. Leakey,
George Light,
Ernest F. Lloyd,
D. W. Low,
James T. Lynn,
John R. Lynn,
E. T. McCormack,
Donald McDonald,
B. L. McElroy,
John D. McIlhenny,
John McMillan,
M. E. Malone,
Edward M. Mancourt,
John H. Mansur,
F. B. Many,
William D. Marks,
C. T. Mason,
John T. Mason,
Edward Matt,
J. H. Maxon,
W. H. Miller,
S. E. Mulholland,
J. D. S. Neely,
H. L. Olds,
G. W. Parker,
C. B. Pattrell,
B. W. Perkins,
A. T. Perry,
Chas. H. Printz,
Eugene Printz,
Chas. S. Ritter,
D. R. Russell,
Dwight E. Sapp,
C. A. Schwarm,
Wm. G. Sharp,
G. A. Strain,
J. D. Shattuck,
Dr, F. Schniewind,
D. C. Spinning,
F. A. Stacey,
J. E. Stacey,
Chas. L. Steenbergen,
J. G. Stevens,
F. W. Stone,
George H. Tayler,
John H. Walters,
L. W. Wells,
George Whysall,
Leigh Wickham,
G. M. Witherden,
W. R. Wones,
Peter Young.

President Doherty:—Gentlemen, the first order of business is the reading of the minutes of the last meeting. What is your pleasure?

It was then moved by A. P. Lathrop, of St. Paul, Minn., duly seconded by C. W. Andrews, of Hamilton, O., and carried, that the reading of the minutes of the last meeting be dispensed with.

President Doherty:—The next order of business is the report of the Executive Committee.

The report of the Executive Committee was then read by Secretary T. C. Jones, Delaware, O., as follows:

REPORT OF EXECUTIVE COMMITTEE.

To the Members, the Ohio Gas Light Association:

GENTLEMEN:—We, your Executive Committee, make the following recommendations:

First.—That Isaac Baxter, J. H. Maxon and Chas. S. Ritter be appointed a Nominating Committee.

Second.—That John R. Lynn, A. J. Stacey and D. R. Warmington be appointed a Committee on Memorials.

Third.—That John Franklin, Geo. Whysall and F. R. Persons be appointed a Committee on Place of Next Meeting.

Fourth.—That Joseph Gwynn, James Salter, W. S. Bowen, Geo. H. Christian and R. A. Dittmar be dropped from membership for non-payment of dues.

Fifth.—That Chas. H. Welsh, Emil G. Schmidt, Neil B. Mallon, W. R. Dixon, Graham McFarlain, D. C. Spinning and Geo. B. Edgar be released from membership at their own request.

Sixth.—That the following be elected to active membership:

NEW MEMBERS.

Blinn, A. C., General Superintendent Sandusky Gas and Electric Co., Sandusky, O.

Clansen, W. F., Superintendent Portsmouth Gas Co., Portsmouth, O.

Daugherty, Geo., with the Warren Gas Light Co., Warren, O.

Dole, S. Milo, Manager Adrian Gas Co., Adrian, Mich.

Field, Frank H., Manager Welsbach Co., Columbus Department, Columbus, O.

Gardner, W. H., Treasurer and Manager Valparaiso Light and Fuel Co., Valparaiso, Ind.

Low, D. W., Superintendent Alliance Gas and Electric Co., Alliance, O.

Malone, M. E., General Superintendent Madison Gas and Electric Co., Madison, Wis.

Miller, W. H., Superintendent of Manufacture Cincinnati Gas and Electric Co., Cincinnati, O.

Mulholland, S. E., Secretary and Treasurer the Lima Gas Light Co., and the Lima Natural Gas Co., Lima, O.

Osborn, H. H., Salesman American Tank and Fixture Co., Chicago, Ill.

Strain, G. A., Superintendent the Bellevue Gas Co., Bellevue, O.
Shattuck, J. D., Superintendent the Philadelphia Suburban Gas Co., Darby, Pa.
Schniewind, Dr. F., Consulting Chemical Engineer the United Coke and Gas Co., New York, N. Y.

Respectfully submitted,

Columbus, O., March 19, 1902. T. C. JONES, Secretary.

On motion of J. W. R. Cline, of Covington, Ky., duly seconded and carried, the report of the Executive Committee was adopted and ordered spread upon the minutes of the Association.

Election of New Members.

It was then moved by John D. McIlhenny, of Philadelphia, Pa., duly seconded and carried, that the Secretary cast the ballot of the Association for the election to membership in the Association of the applicants recommended by the Executive Committee in its report.

SECRETARY JONES:—Mr. President, it gives me great pleasure to comply with the motion just adopted, and I hereby cast the ballot of the Association for the election to membership of the applicants referred to, and declare them duly elected members of the Ohio Gas Light Association.

THE PRESIDENT:—It is the desire of the Chair, and, I am sure, of all the older members present, that the gentlemen whose applications have just been favorably acted upon and who are now members of the Ohio Gas Light Association, will feel free to take an active part in these proceedings. The next report in order is the report of the Secretary and Treasurer.

T. C. Jones, of Deleware, O., then submitted the following

REPORT OF SECRETARY AND TREASURER.

To the Members, the Ohio Gas Light Association:

GENTLEMEN:—I have the honor to present herewith the eighteenth annual report of the Secretary and Treasurer for the period between March 20, 1901, and March 19, 1902:

New members admitted at the seventeenth annual meeting..	27
Released from membership	10
Deaths	3
Active members at this date	225
Honorary members at this date	13

Financial Report.—Receipts.

Balance from last year	$ 427 81
Received from dues	420 00
Received from initiations	145 00
Received from sale of half tones and etchings	14 50
Received from gas journals for report of seventeenth annual meeting	151 00
Total	$1,158 31

Expenditures.

Printing and stationery	$ 178 93
Postage	25 60
Expense of reporting seventeenth annual meeting....	151 00
Secretary's salary seventeenth annual meeting......	300 00
Expense of Executive Committee	8 75
Telegrams and telephones	7 69
Express	2 30
Badges	13 75
Balance on hand as per certified check	470 29
Total	$1,158 31

Respectfully submitted,

T. C. Jones, Secretary and Treasurer.

Approved: E. E. Eysenbach, Finance Committee.

It was then moved by Mr. Andrews, of Hamilton, duly seconded by Mr. Whysall, and carried, that the report of the Secretary and Treasurer be received, adopted and ordered spread on the minutes of the Association.

LETTERS OF REGRET.

President Doherty:—Gentlemen, we have some letters and telegrams of regret. I will ask the Secretary to read the names of the gentlemen sending the same.

The Secretary:—I have received from the following gentlemen letters expressing regret at their inability to be present at this meeting:

Thomas D. Miller, Dallas, Texas; Fred R. Persons, Toledo, O.; S. S. Stratton, Chicago, Ill.; A. B. Slater, Providence, R. I.;

James Somerville, Indianaplis, Ind.; John P. Harbison, Hartford, Conn.; Louis A. Ferguson, Chicago, Ill.; Senator Francis E. Warren, of Wyoming; W. E. Steinwedell, Belleville, Ill.; E. C. Humphreys, Cincinnati, O.; Alten S. Miller, W. R. Beal, William Henry White and Alex. C. Humphreys, New York City.

I will read the following telegrams:

From B. E. Chollar, St. Louis, Mo., addressed to our President: "Brace up. You will find it dead easy."

From Irvin Butterworth, of Denver, Colo.: "Convey to the members my deepest regrets that I am necessarily absent from the first Ohio meeting that I have ever missed."

From Donald McDonald, Louisville, Ky.: "My spirit is with you. Body unavoidably detained here."

Letters were also received from the following Gas Association Officers expressing their regret at not being able to be present:

Henry W. Douglas, Secretary Michigan Gas Association; N. W. Gifford, Secretary New England Association of Gas Engineers.

The Chair then announced as the next order of business the

PRESIDENT'S ADDRESS.

HENRY L. DOHERTY.

I know of no unusual developments in the gas business during the past year. Much progress has been made, but it has not been of a sensational character. There has been a healthy growth toward a better understanding of the business rather than the adoption of better operating methods. Tracing through the various steps in the manufacture of gas, the following points of interest occur to me: In large works a considerable saving may be accomplished by machine stoking, and labor troubles may be thus avoided to a great degree. From results obtained in European gas-works, it would not seem improbable to suppose that we can save from 5 to 7 cents per 1,000 cubic feet on this item alone in works having an output of 2,000,000 feet or more per day.

It has been demonstrated that the washing and scrubbing of gas can be effectively done without the use of mechanical scrubbers. The improper distribution of water in tower scrubbers has had much to do heretofore with the ineffectiveness of this form of apparatus. By flooding the contents of the tower scrubber very effective results can be obtained. Several methods for the

intermittent introduction of a large quantity of water are now in use. A simple form of this apparatus can be found illustrated in the Wrinkle Department of our last proceedings. I doubt, however, if tower scrubbers will ever succeed in rivaling the new brush scrubbers, which are now yielding ammoniacal liquor having a strength in excess of 25 ounces. Condensation can sometimes be greatly assisted by water cooling towers. Water used for condensation can be taken at atmospheric temperature and cooled by air to temperature lower than the air used for cooling, provided that the air is not close to the saturation point. The temperature of the condensing room sometimes approaches 100 degrees Fahr. in the summer time, and we have to resort to the use of cold water, which might not always be obtainable, or else we must cool this water below the atmospheric temperature by evaporation.

Purification is now largely a problem in investment. The use of a small positive blower belted to the exhauster is a very satisfactory and effective means of constant revivification of iron oxide.

Several new proportional meters are now in the course of development, and I am confident we will some day have a satisfactory substitute for the big, cumbersome, wet station meter now generally in use.

The increased sales of fuel gas have relieved the necessity for large holder capacity. In the case of one gas company with which I am acquainted, their rate of send-out is so uniform that the height of their holder does not vary greatly throughout the 24 hours, except between 10 o'clock at night and 6 o'clock in the morning. Another company which has a large sale for fuel gas now has an annual output of 288 times its maximum daily output.

Water-gas making is so largely a problem dependent upon the oil market that little is left for interesting comment. A great saving, however, can be made in fuel by the use of a higher blast pressure, which will give you a higher velocity in your fuel bed, and result in a much larger production of CO_2 during the blast, which means that you get more of the heat of your carbon in the fuel bed where it is most needed, rather than in the carburettor and superheater, where you now have an excess. Your blowers and piping should be of sufficient size and so constructed that you can get, if necessary, a 20-inch fall of pressure between the bottom of your grate bars and the top of your fuel bed.

Two or three companies with which I am acquainted have adopted iron meter connections, and we think them an improvement on lead.

Considerable development has been made in the last few years in large gas engines. The adoption of these large gas engines by big power users cannot but prove advantageous to the development and use of the smaller gas engines. In one city several gas engines are used in isolated electric light plants, purchasing their gas from the gas company. I expect to see the ordinary steam engine largely superseded by internal combustion engines during the next few years.

Residuals.—No particular complaint exists at present on the prices received from residuals, but I do not think we are getting all that we might get from residuals, and especially from our ammonia. Large quantities of anhydrous ammonia are used in every city for refrigerating purposes, and the users pay approximately 25 cents per pound for it. The market for aqua ammonia is practically unlimited. It is a desirable substitute for soap, and it is also a most desirable fertilizer for quick results. I think there is scarcely a town in the country that could not use all the ammonia produced at the local gas-works in the form of aqua ammonia as a substitute for soap and as a fertilizer for lawns and plants. It is the only fertilizer which will give almost immediate results.

I think nothing offers any greater opportunity for increasing our earnings than the proper handling and marketing of coke. In Denver we have heretofore found it almost impossible to sell our coke at a price which would net us $2.75 per ton in our yard. During the past year we have made the matter of handling coke a department of itself, under the direction of a former employe in our soliciting department, and by advertising, careful treatment of coke consumers, prompt deliveries and proper screening, we have now developed a market which takes the coke faster than we can make it, and it will net us in the yard more than $4 per ton. This subject will also be treated by discussion at this meeting.

Program for This Convention.—We have this year made a radical departure from our program methods. We believe that the discussion of important subjects at our convention will create more interest at our gatherings and prove more beneficial to our membership. It is presumed that this program method will be

repeated if it meets with the approval of the members, and it is reasonable to suppose that it can be made more effective at subsequent meetings. There are many important problems which confront the gas fraternity, but we have not tried to include them all. It is also difficult to determine what subjects are of most importance to the greatest number. Every member of this Association should feel in a measure responsible for its success, and by simply requesting discussions of such problems as you happen to be interested in you will do much toward the success of these meetings.

Advantage of Dividing Association Work.—There is probably no business in the country which is so thoroughly organized, and in which co-operation without co-ownership exists to the same extent. If the various gas associations have done nothing more than to bring the men of this business in contact with each other, they have accomplished enough to have fully warranted their existence. Gas associations have done more than this, and have had a most potent influence on the development of this field of industry, but there is more work still to be done than has already been done.

New gas associations are constantly being born, and while many of our oldest are well organized and equipped, it seems to me the next step toward securing useful work by these associations would be some harmonious plan of co-operation whereby the work would be so divided that a smaller field could be covered by each, and this particular field better covered. Up to the early years of the last decade our gas associations seem to have been devoted almost entirely to the consideration of engineering problems, but in the latter half of this decade a pronounced change has occurred, and we find associations have drifted almost entirely into mercantile organizations. This fact has called forth many lamentations from the old school of gas engineers. They complain bitterly that the present gas manager is no longer a manufacturer but a merchant, and that the new school has neither the time nor the interest for any other problem than the sale of gas. It seems to me that both are wrong in a measure. The gas business is not strictly a manufacturing business, nor is it wholly a mercantile business. To devote all of our time to one branch and none of our time to the other must necessarily be a mistake, and we should devote our time to these two branches in proportion to the necessities and possibilities which each branch presents.

Personally, while I may admit that the manufacturing or engineering end of our business is still in a crude shape, I believe that, generally speaking, a given amount of time and a given amount of investment will bring larger returns if bestowed upon the commercial side of our business than it will bring if devoted to the engineering side; and, after all, we are in the business to make our plants the most productive for an indefinite period.

When a plant is too large for one man to conduct both the engineering and commercial sides, the two branches should be separated; and when our associations are confronted with too many problems to give to each the careful consideration due it, the field of their work should be contracted, or divided, to enable each to cover its chosen field in a creditable manner. We now have three associations which are national in their character—the American Gas Light Association, the Western Gas Association, and the Ohio Gas Light Association. Besides these three are sectional organizations, such as the New England Association of Gas Engineers and the Pacific Coast, Wisconsin and Michigan; and there are also numerous state organizations. We have not a single association which devotes itself entirely to engineering work, and I believe such an organization is badly needed. There are already so many organizations that it seems unwise to suggest the formation of additional ones, but it has often occurred to me that a great step would be accomplished in our organization work if one of these larger associations could be devoted strictly to engineering work and another one of them devoted strictly to commercial work.

While I am a member of all three of the larger associations, I have heretofore taken so little part in the affairs of the American Gas Light Association and the Western Gas Association, that I hesitate to suggest any change in their methods, as in some people's minds a suggestion aimed at improvement carries with it an implied criticism; but I am anxious to illustrate the point I am trying to make regarding the organization of gas associations amongst themselves, and for this reason will presume upon the generosity of the gas fraternity to point out the advantages which may result from a division of their work. Let us assume that the American Gas Light Association should hereafter devote itself entirely to engineering work, and the Western Gas Association should devote its time entirely to commercial work. This would tend to change the membership of these two associations, until

eventually we would expect to have one organization composed entirely of engineers and the other almost entirely of commercial men. It is reasonable to suppose that every gas engineer in the country would eventually affiliate with the American Gas Light Association, and that all of the commercial men would later be affiliated with the Western Gas Association. Both would then enjoy a more cohesive membership that could unquestionably render more useful service, and greater vim and interest would characterize their conventions.

The effect on the gas companies would be equally beneficial. Gas companies are rapidly drifting towards special managers of each department, and the engineering executive of a gas company cannot cover all of the engineering subjects treated at a convention without attending them all, and he is compelled to stay through or "loaf" while problems in accounting and other matters are being discussed, all of which he does not understand or in which he has no interest. These same arguments are applicable to the man in charge of the office, or other work not in the line of engineering, and this man must either stay through the discussion in which he has no interest and which he does not understand, or he must drift from the convention hall and amuse himself in some other manner while subjects of an engineering character are being considered. This condition has a disintegrating effect upon our conventions. We also have another serious difficulty which confronts two men coming from the same company. One may be the engineer and the other the secretary, and both of them may not be able to absent themselves from their duties simultaneously, while, if one association were devoted to engineering work and another to commercial work, the attendance of the proper man would always be assured and much interest would be added to the convention proceedings.

I think it of great importance that we should have some organization amongst the gas fraternity similar to the Institute of Electrical Engineers, which would devote its efforts exclusively to engineering and research work; and if some portions of such work cannot be accomplished by the present associations, I believe it would be highly beneficial to the gas business as a whole if an institute of gas engineers should be formed. The memberships of these three organizations are nearly identical, few of the members, if any of them, belonging to but one organization, and many of them belonging to all three.

Future Policy of This Association.—The Ohio Gas Light Association is in a very unique position. A large portion of our membership comes from beyond the border of our state, and it cannot be classed properly as either a state organization or a national organization. The character of this Association must be determined upon by its members, and some definite plans for its future decided upon. It was formed as a state organization. Its membership is largely composed of managers of small plants, who must spread themselves over the entire field of gas manufacture, distribution, accounting and the development of new business. The original object of this Association was unquestionably the benefit of the managers of small gas companies, and in justice to them this Association cannot take up a special field of work unless the membership should unanimously be in favor of such a proposition. I earnestly hope that the members in attendance at this convention will express themselves on this point. If it is their desire that the Association be made national in its character, I would suggest the appointment of a special committee to confer with the officers of the other two large associations and determine whether some special work could not be done by each of these three organizations if their work should be divided, and to determine whether such division could be made as would be mutually agreeable to all.

Affiliation With Other Engineers.—I also think that gas men should bring themselves into closer relationship with other engineers. They have so isolated themselves that gas engineering is not recognized as a profession, and many of the terms we use, which should be common to all branches of engineering, are different in their meaning from those adopted by other more generally recognized branches of engineering. To illustrate this, we might take our definition of a candle-foot. This to us means a certain quantity of illumination, while to all other branches of engineering a candle-foot means the unit of intensity. To us a candle-foot is the product of yield times candle-power, and to obtain a standard quantity of illumination namely, a candle-power hour, we must divide this product by five, hence it seems to me that the term candle-foot, as we use it, should be discarded to prevent misunderstanding. It seems to me we should adopt as our unit of quantity of illumination the candle-power hour, which means the quantity of illumination of a standard candle burning one hour; and as our standard of intensity we should adopt the candle-power foot which is used by other branches of engineering, and which is

interpreted to mean the unit of intensity of light 1 foot from a standard candle. By affiliation and harmonizing with the other branches of the engineering profession, we can hope to receive beneficial results. For instance, our work has almost entirely been confined to the manufacture of illuminating gas, but I believe the time is fast coming when we will find it to our advantage to manufacture a cheap fuel gas for firing our benches and for power.

Producer-Gas Firing.—The engineers in steel-works and glass factories have devoted much time to the solution of some of these problems, and some interesting data can be found in the proceedings of other engineering associations. It makes me feel a bit cheap to go into a steel or glass plant and find them successfully using gas for firing their furnaces, and testing and determining the constituents of their gas with a dexterity almost unknown in a gas-works, and yet we gas engineers seem to like to boast that we cannot make a fuel gas suitable for use, and cannot use it after it is made. This subject will be touched upon in our proceedings.

Selection of Employes.—I think every gas company should be more careful in the selection of its employes. Many branches of work can employ men who have been specially trained for their engineering positions, and while this is hardly possible for the gas business, yet we can hire men who have the necessary education, and these we must teach for our particular business. We are running a business and not a school, and it seems to me highly important that where possible we should hire men who have been educated for general engineering work, and not men to whom we much teach the very rudiments of arithmetic in order to fit them for the problems which they must solve every day to improve our operating efficiency.

Fuel Gas and Gas Appliances.—I consider fuel gas, in its universal sense, to be out of the question, or at least until some method for the cheap production of oxygen shall have been found. While a field of enormous dimensions already exists, the acquisition of this business rests almost entirely with the wisdom and ingenuity of the designers of our fuel-gas appliances. The sale of gas at $1 per 1,000 cubic feet for heating purposes which contains 650 B. T. U. is equivalent to selling heat energy at about $1.54 per 1,000,000 B. T. U., this in turn being equivalent to about $53 per ton for good bituminous coal. To make a reduction in the selling price of gas which would even in a measure compensate

for this vast difference in cost to the consumer of heat energy is simply out of the question, and our only hope lies in perfecting our fuel-gas appliances.

Our gas-appliance business is in a crude condition, in spite of the fact that so-called satisfactory results are often obtained with most of the appliances which we use. Satisfaction, after all, is a relative matter, and we should aim to have the best rather than to have something which is merely a little better than was used a few years ago. I have never seen any tests of fuel-gas appliances which were at all comprehensive or conclusive. Enormous opportunities for inaccuracies always exist, and the work has generally been done by men who have not taken the trouble to study the laws of heat and combustion. While it is generally an accepted fact that every fuel-gas appliance has some favorite rate of gas consumption at which most economical results will be obtained, yet none of us have ever made this a subject for special research work, or at least not to my knowledge. I might cite as an example our present water heaters. I not only criticize their manufacture, but I also criticize their method of installation. I know of nothing which would so increase our business as our ability to obtain and install a water heater which would have a working efficiency beyond that now obtained, but which is not impossible with the present existing prices of gas and the knowledge of the engineering problems involved. At present we must contend with several causes of inefficiencies in independent water heaters, as follows:

Different rates of gas consumption.

Irregular drafts and radiation from boiler and piping, and radiation from water heater when not in use.

Radiation from boiler and piping can be partially prevented by an insulated covering on the boiler. Irregular drafts can be practically overcome by the use of a broken length of fuel pipe with a canopy above it. The draft in your chimney must constantly change, due to the intermittent use of the water heater, or due to other appliances using the same or adjacent flues. If the draft is excessive, more air is drawn through the heater than is needed to support combustion, and the heat absorbed by this excess air is a net loss. As the flow of gas varies only as the square root of the pressure, and not directly in proportion to changes of pressure, the efficiency of the heater is not much affected by a slight change in pressure, and we could obtain fairly economical results if the heater were so arranged that whenever it was turned on we would

get approximately the most favorable rate of gas consumption. This could probably be done only by the use of some sort of stop-cock which could only be in the position of "full on" or "entirely off." Radiation from the heater itself is a serious matter, since being connected with the flue it continues to induce a draft even after the gas has been turned off, so long as the water is at a temperature higher than that of the air. This causes cold air to come in contact with the coils of the heater, and as soon as the water contained in these coils is cooled it drops to the bottom of the heater, and the hot water comes over to take its place and in turn is cooled and drops to the bottom. If you will stop to think for a moment, you will see that the circulation in your heater reverses when you turn off the gas. I think this loss could be most easily prevented by so arranging a gas stop-cock that both the gas and the water will be turned off and on at the same time. With such a stop-cock on the water pipe, no circulation would take place, and only the heat contained in the water in the coils of the heater would be lost. I cite this merely as an example. The same general criticisms are applicable to almost every other appliance which we use. A good water heater would not only give us the gas consumption of that water heater, but would put hundreds of gas ranges in constant use. Cheap gas stoves for the heating of rooms have materially curtailed our opportunities in this line. A gas heating stove to be extensively used in an ordinary climate must have a flue pipe which will discharge out of the room the vapor of water and the CO_2, and as little as possible of the heat generated by combusion. I am not afraid that our combustion is not complete, and I see no particular harmful effect from a much larger percentage of CO_2 in the air than we are likely to get, but I am afraid of water vapor. CO_2 is as inert as nitrogen, and if any CO is produced it is in too insignificant a quantity to be considered. I doubt if the burning of 50 feet of gas per hour in a room, in even a very crude heating stove, would produce as much CO as would result from the smoking of one cigar.

I think we must change our methods to make ordinary gas heaters satisfactory. I think that eventually we will aim to develop the maximum quantity of the heat of the gas in the form of radiant energy, which travels without regard to the laws of gravity, which can be directed and controlled, and which warms the body and the furniture without expending itself entirely on the atmosphere of the room. To get a large percentage of radiant

heat we must burn our gas at a high flame temperature and direct the heat of the flame on some medium which will enable it to give off all excess heat in the gas above a certain temperature in the form of direct heat rays. This result could probably best be arrived at by the use of recuperative flues which will deliver the heat in the outgoing gas to the incoming air and gas.

Developing Our Market.—I do not want to omit to answer in some way the charge which is frequently made that the engineering branch of our business is falling into neglect, owing to our entire efforts being devoted to the problem of selling gas. I do not think this charge is well founded, and I think none of us are more anxious to sell gas than is warranted in the light of recent experiences. It is not a difficult matter to double the earnings of a company by developing the market, and it most certainly is impossible to double the earnings of any ordinary company by improving its operating conditions, no matter how much time and money are so expended. Another thing which must not be overlooked is the possibility of reducing our costs per 1,000 by increasing our sales. I might cite an instance of two gas companies with which I am reasonably well acquainted, both paying about the same amount of taxes and interest on the intrinsic worth of their property. The first company has extensively developed its gas market, and its charge per 1,000 for taxes is about 2.7 cents and for interest approximately 22 cents; while the second company has not developed its market so extensively and its taxes amount to about 10 cents per 1,000 cubic feet sold, and its interest charge is about 47 cents. By doubling the sales of gas this latter company can diminish its cost per 1,000 to 28 cents, and I know that no such saving is possible in the manufacturing end of the business.

Money judiciously expended on fuel gas campaigning can be made to pay 100 per cent. on the investment, and we can afford to spend much more on such a campaign than we have heretofore believed was possible. If a fund of 15 cents per capita is provided for the first year's campaign, the earnings from the increased consumption due to this campaign will keep up the work indefinitely, provided the money is judiciously expended. Personally, I do not believe in free service pipes, I do not believe in giving away gas stoves, and I do not believe in selling gas stoves at cost. I think the problem which confronts us is one of how much money we can afford to spend to increase our consumption, and how can

this money be expended to give the greatest increase in consumption. I believe that the greatest increase in consumption can be obtained by expending this money to make people want stoves, and I also believe that you can make these people help carry along your campaign, when once you have made them want a stove, by paying you more than it cost you. There is a general and prevalent idea in the gas business that the main reason why people do not use gas for cooking is the obstacle of first cost. Now, if this reasoning is proper and sound, everybody in towns where gas stoves are free would immediately put in a gas stove, and yet in some towns where stoves have been given away there are not as many in use as where they have been sold. This fact is unquestionably an absolute proof that the main obstacle in putting gas stoves in use is not their first cost. The question of how to make people want stoves is one largly of opinion. I think, as a general proposition, and with the proper funds at your disposal, it is safe to work every avenue that you do not think ineffective. In other words, take advantage of every opportunity that offers, even though it might be unpromising. Time will be apt to demonstrate the worth of every opportunity at a small cost.

Personal solicitation always seems to be the most effective, but advertising is really another form of solicitation, and your solicitor may not be able to get an audience with people that your advertising will reach. I never heard of any one buying a stove on advertising alone, and yet I am confident it is impossible to get superlative results without advertising. I believe daily newspaper advertising is the best of all local advertising, and it is a simple form of solicitation that is methodical, cheap, systematic and persistent. Your advertisement is a written solicitation, and presumably written by an expert. It can approach people whom you cannot reach in person, can enforce attention without irritation, appeals to your prospective consumer in all sorts of humors and in all stages of "business," and if persistently followed up will some day strike that prospective consumer when he is in a receptive mood, and he will at least give your solicitor an interview when he next calls. While, as previously stated, I do not think it possible to stop the practice of putting in services free when once it has been established, yet where services are being put in free every protection should be taken to reserve their ownership by the gas company, so far as this is possible.

Uniform Accounting.—Uniform accounting would also greatly benefit the gas fraternity. A committee of the American Gas Light Association has recently issued a report which is very comprehensive, and I advise you all to obtain a copy of this and acquaint yourselves with its recommendations. The advantages to be gained by uniform accounting are too innumerable to even mention. The most important is the facility it affords for different managers to compare their costs for the same class of work, and thus determine whether they are on a favorable basis as compared with others.

Publication of Our Proceedings.—I also feel that some effort should be made to publish our past proceedings in convenient form, and to publish our proceedings hereafter each year. At present the funds of the Association will not warrant this additional expense. There are several methods open to us for the acquisition of these funds. One would be to solicit a greater membership amongst the gas men from all over the country, and I believe the appeal would be liberally responded to, if we made it plain to them that it was necessary to have their support to enable us to publish our proceedings. Another way would be to raise our dues. I am not, however, in favor of this, as I fear we might drive some of our members from the Association, but I think there are many of us who would be willing to contribute at least $10 instead of $3 per year, as the dues are now, and we could divide our members into two classes—known as the contributing membership and the ordinary membership. No distinction would be made between these two classes of members, except that the members of the contributing class would pay $10 per year, while the dues for the others would remain as at present. Published proceedings always make an excellent avenue for advertising, and this opens up another possible plan for obtaining the funds for the publication of our proceedings. I would suggest that a committee be appointed to consider the means for raising funds for the publication of our proceedings, and also to direct how these proceedings shall be published, and that such committee be instructed to report at our next annual meeting.

Differential Rates.—During the past year there seems to have developed a tendency to consider the sale of gas for illuminating and fuel purposes at different rates as illegal discrimination. If this contention should be sustained by a court of high jurisdiction

I fear its results to some gas companies would be almost disastrous. No matter what our private opinions may be regarding the equity, legality and desirability of differential rates, we all must agree that we should be free to act as we consider best, and not be hampered by any unfavorable limitations. I therefore hope that all of you will contribute every suggestion possible to the demonstration, beyond question, of the justice and legality of differential rates.

Appointment of an Editor to Report Progress.—It is customary for the Presidents of these associations, in their annual addresses, to treat of the developments of the business during the preceding year. This is a matter which can seldom properly be prepared by the President, and as it is the essential duty of the Association to call the attention of its members to all progress which has been made, I think some member of this Association should be appointed to report each year's progress. If a man of this sort can be selected who reads all the published gas literature, including, if possible, the French and German gas journals, much valuable information can be imparted in this way to our members.

Research Work.—If any member of the gas fraternity wishes to do some valuable research work, but does not know what class of work to select, I would suggest the possibility of enriching gas with its own constituents. Acetylene, which has a higher illuminating value than any of the constituent gases which go to make up coal-gas, can be produced by passing hydrogen between the carbon points of an arc. This, however, necessitates furnishing the required heat of formation by a very expensive process, and would therefore probably not be a commercial success in the enrichment of gas. It might be possible to break up marsh gas and form acetylene gas by passing it between the carbons of an electric arc. In this case no heat of formation would have to be furnished, as the decomposition of the marsh gas would supply more heat than is required for the formation of acetylene gas. I have seen a statement in some of our text books that the hydrocarbons contained in coal-gas, including marsh gas, would break up and form the series of hydrocarbons if subjected to a high temperature. If this is so we could pass a certain portion of our gas through a scrubber containing cold, heavy tar oil, and absorb all the illuminants. From here the residual constituents, including the marsh gas, would pass to an externally fired retort and be brought to the

temperature where marsh gas would break up and form the illuminating series, passing out of this retort through recuperative furnaces to heat the incoming gas, and would then go to the scrubbers of hot tar oil, which had previously absorbed the illuminants of the gas when cold, and these illuminants would again be given to the gas. The results obtained by exposing gas to high temperature would lead to the belief that hydrocarbons always break down in the series going to the hydrocarbon containing the least amount of carbon, rather than to the hydrocarbon containing the greatest amount of carbon. This, however, is in contradiction of the fact that naphthaline appears in water-gas when the temperature of the carburettor and superheater is too high. Apparently in this latter case the richest hydrocarbon is formed rather than the lesser series. By heating gas in a furnace of incandescent carbon, or by some similar method, we might be able to build the hydrocarbons up in carbon rather than to break them down.

Another valuable piece of research work which might be accomplished by some one having the time and inclination would be the subject of the flow of gas through pipes. The controversy regarding the flow of gas at different pressures, between the advocates of high and low pressure, seems to me to be almost inexcusable. If our present laws are inaccurate some of us should develop enough energy to determine accurate laws. Unless the old laws which we have accepted for 50 years are inaccurate, there is no great advantage in the distribution and transmission of gas at very high pressure.

The opportunity for research work in fuel and lighting appliances is almost unlimited. While a given amount of gas burnt will yield exactly the same quantity of heat no matter how it is burnt, yet flame temperature so greatly influences the efficiency of many of our appliances that this field alone offers many opportunities for improvement.

The preheating of gas and air by the waste products of combustion, with a view to obtaining a greater flame temperature for both lighting and fuel purposes, has never been explored to any considerable extent.

The possibilities of increasing the efficiency of incandescent lighting by a system of recuperation are almost unknown. This, besides being economical, might also permit us to use mantles which are less fragile and to all intents and purposes practically

indestructible.. Valuable results could also be obtained by the mechanical mixing of gas and air, very intimately, prior to combustion.

The field of chemistry in gas manufacture offers an unending opportunity for advantageous research work. The effect of electrical energy waves on gas during its manufacture, such as Roentgen rays, and other rays of extreme chemical activity, is another field of promising possibilities. We might also find that by carefully preparing solutions of oxide to use for mantles for incandescent lighting it would be possible to develop nearly all of our light energy in the form of those selected rays which are the most effective to the human eye at the sacrifice of the useless rays at each end of the spectrum. I am also convinced that the physical texture of the mantle has some influence on the quality of the rays which it emits.

Future Program Methods.—If the present program method fails to prove satisfactory at this meeting, I suggest going back to the former plan of having papers, but that an amendment be made of having at least two reference papers at each of our conventions. By reference papers I mean some paper which will always remain a standard in gas literature, such as a resume of the development of each piece of apparatus used about a gas-works. For instance, I would very much like to have in my library a paper tracing the development of the present gas bench, properly illustrated, and also giving all the important forms of benches that at one time or another have been used. A paper on hydraulic mains would be equally interesting and valuable, as would also a paper on scrubbers. I am sure that any one volunteering the compiling of such papers as these would meet with a very warm reception from the program committee of any of our associations.

I announce with much regret the death of three members of this Association, Wm. Stacey, President of the Stacey Manufacturing Company; H. C. Kirby, President of the Goff-Kirby Coal Company, and Edward Wehle, of Louisville, Ky.

In conclusion, I wish to express my appreciation of the earnest and intelligent work of our Secretary, T. C. Jones. He has worked hard and conscientiously for the success of this meeting, and if this convention proves satisfactory to you all I hope you will record your appreciation by a hearty vote of thanks to our Secretary.

C. W. Andrews:—Mr. Secretary, I move that a committee of three be appointed by you to consider the recommendations contained in the President's address and report to this convention. (Seconded; carried.)

Secretary Jones:—I will appoint on that committee Messrs. A. P. Lathrop, St. Paul, Minn.; George Whysall, Springfield, O., and John D. McIlhenny, Philadelphia, Pa.

The President:—We will now take up the Novelty Advertising Department.

NOVELTY ADVERTISING DEPARTMENT.

B. W. PERKINS, EDITOR.

The follwing have been received in response to requests for advertising novelties:

A. L. Woollen, Fishkill on Hudson, N. Y.: "I am rigging up lamp posts with nice globes to be placed in prominent places about the city, giving the great advantages of gas as fuel and light painted on the globes with nice letters. Reducing complaints and increasing the consumption of gas for lighting by placing a photometer in the window, with a card showing the working of it, and managing to keep it at 24 candle-power. Several mornings during the month I place pancakes, nice toast and other materials on the different appliances in the window, and find it very effective.

H. L. Olds, of Bloomington, Ill., always keeps a gas range, surmounted by a sign, on his wagon.

C. B. Patrell, Mansfield, O., uses solicitors, whom he supplies with literature, etc., and pays them the $2 that the range is sold for over the cost. A record is kept of the reasons why gas is not used, and future visits are made to try and overcome their objections.

Eugene Printz, Zanesville, O., who is in competition with natural gas at 20 cents per 1,000, keeps his lighting business by house to house canvass and supplying incandescent gas burners with renewals and repairs free.

John McMillan, Conneaut, O., uses his show windows, dressed in a novel manner, a photo of which he kindly furnished. He says: "We have given away 1,500 feet of gas to all new consumers each spring, in order to get them to come on sooner, and

this has proved a very good ad. for the reason that the new consumer receiving the 1,500 feet would use a good portion of it showing it to his neighbors, as he would tell them it did not cost him anything to show it, as the gas company had given him the first 1,500 feet used, and this would get his neighbors to wanting gas, and I can trace quite a number of our consumers to the giving away of 1,500 feet.

J. T. Mason, Milwaukee, Wis., uses a postal card, the reverse side of which contains well-executed half tones of prominent places, buildings, parks, monuments, etc., in and about Milwaukee. Above or below the picture are printed in red ink, appropriate short notices of gas and its uses. These cards are sent to all non-users of gas.

C. R. Faben, Toledo, O., uses the newspapers, theatre programs and the back of gas bills. Upon the backs of the latter are short catchy ads. illustrated with an appropriate picture to arrest attention.

J. M. Robb, Peoria, Ill., uses press clippings supplied by parties who are in that business.

The Northwestern Gas Light Company, Evanston, Ill., has a huge sign on top of one of its gas holders, on which is put in letters 3 feet high, "Cook with Gas."

Irvin Butterworth, Denver, Colo., says: "If you want an ad. that is a real novelty, here is one, the credit for which belongs to Ben A. Block, of this city. Let the gas company carry the following ad. in the daily papers for, say, a week: 'Wanted, to rent, all the dogs in the city, just for two days, at 10 cents per day; you keep the dog and we pay you the cash. Any old dog will do. Bring your dog to the gas office at 10 o'clock next Saturday morning.' The carrying of this ad, will cause no end of comment and speculation, and curiosity will be aroused to a high pitch. At 10 o'clock on the Saturday designated, there will be a big crowd of men, boys and girls and barking and fighting dogs gathered before the gas office, some with dogs to rent, and others to see what on earth the gas company wants with so many dogs, or with any dog for that matter. As dogs are brought in turn to the gas company's 'dog clerk,' let him tie about the neck of each dog a tin, leather or other suitable tag on which is stenciled the legend, 'Buy a Gas

Stove.' Then let him tell the owner to bring his dog back in two days with the tag on him and get his 20 cents rent money. If this scheme does not sell gas stoves and popularize the company, then that community is simply too 'dog-goned' dignified to appreciate a good thing."

C. A. Schwarm, Lorain, O., uses printed matter, which is distributed among consumers; they are for enlightening them about the merits of coke, gas and electric lights; they also publish notices of fires and explosions caused by gasoline or acetylene, which are obtained from clipping bureaus.

Henry L. Doherty, Denver, Colo., says: "One of our earliest advertisements last season was an ad. in the street cars. The cards were changed every fourth day, and each successive card read as follows: 'If'—'If you love'—'If you love your wife'—'If you love your wife, buy her'—'If you love your wife, buy her a gas stove.' We adopted this method to attract people's attention to the space, and we think it was effective. Every Friday morning we have a 'cooking school' at our office. By arrangement with one of the butchers of Denver, we had a butcher's block set up in our office and a side of beef cut up in view of the class to show them the location of the various cuts of meat, and to tell them the best uses for these different portions of the beef. We are now giving the matter of marketing our coke considerable attention; and have done more or less advertising to popularize it. The only novelty we have introduced in this department has been the purchase of a number of nice white duck bags, which we filled with coke and gave away as samples. We have also had small boxes made, containing three compartments, one for each of the different sizes of coke, and these have been placed in the numerous district offices of the A. D. T. Company, we paying their agents a commission of 25 cents per ton on all coke they sell. In the Milwaukee gas office they have a similar arrangement to this, which I think is even more effective. They have their coke contained in large clear glass jars in a prominent place in their office, and at a favorable height to catch the eye of every one entering the office.

"We have the following additional forms of advertising here, none of which is decidedly novel: We put some kind of paster on our bills each month, containing some advertisement or notice to the consumer. We have two or three movable bases to contain stoves, on which we place different sample ranges for display in

some prominent portion of our office or on the sidewalk in front of our office. We furnish the demonstrator, the range and the food to any church in town which wishes to give a "cooking demonstration," the church generally charging an admission. These church demonstrations have been very successful. We also keep a demonstrator out on what we call 'house demonstrations.' A solicitor borrows a kitchen and invites in all the neighboring ladies who do not have gas stoves, and a demonstration is then given of scientific cooking on an up-to-date range, a display meter being attached to the supply pipe of the stove to show how much gas is used.

"Just prior to Thanksgiving we rented a large assembly hall at the Brown Palace Hotel, and advertised to give a free demonstration of how to cook and serve a Thanksgiving dinner. We cooked a full course dinner and had a fancy table set to show just how to do the thing in proper style. Admission was by ticket only, and the scheme was so popular that we had to repeat the demonstration several times to accommodate the applicants for tickets. The Standard Oil Company has an agency here for 'Blue Flame oil stoves,' and has a very prominent corner to display its goods. In a measure to counteract that company's efforts on oil stoves, we carried for several weeks an advertisement in all the street cars in the city, and occasionally in the daily papers, worded as follows: 'If you are going to buy a stove, buy a gas stove, otherwise you are buying what progressive people are throwing away.' "

R. I. SPEARS, Little Rock, Ark., last season used the daily papers and distributed 500 booklets each month, and followed with personal calls from solicitors; as it resulted in the sale of over 300 ranges, they consider it a good scheme.

A. P. LATHROP, St. Paul, Minn., carries a one-line ad., "Cook with Gas," over the daily menu card that is published in their papers.

IN SOUTH BEND, IND., we have attractive ads. painted on all the waste paper boxes that stand on the street corners for the convenience of the public. We also had some large wood sign boards about 6 feet square, on which was painted "Use Gas for Fuel," "Use Gas for Light." These signs we nailed to posts set in the river as near the middle as the depth would permit, where they were in plain sight of everybody. While this is a very simple

thing, we never did anything in the advertising line that attracted more attention. We also had large bill boards, 12 by 16 feet, put up on the guide frame of our larger holder, upon which we pasted posters, etc. Another attractive advertising scheme was large stencils cut from stiff paper, backed by tissue to hold the letters together and diffuse the light. These were made large enough to entirely fill the lower sash on the front windows, a light was left burning all night, and the upper sash covered with a shade. By this means the light could only penetrate the portion covered by tissue paper, and could be distinctly read on the opposite side of the street. These stencils can be cut by first making the letters out of tin, then laying them on the paper and cutting around them wih a sharp knife. We have also used large colored posters, which are posted at intervals during the summer on boards that are not likely to be used for other purposes. Another good ad. noticed recently was a long banner, which one of our enterprising laundrymen had attached to the top of a scaffold of an unfinished smokestack. It attracted a lot of attention, and we regretted the fact that we had not thought of it ourselves.

St. Louis Gas people send a copy of a large poster, which we know from experience is a good thing.

Another good ad. is shown by the accompanying cut and description, taken from the *New York Herald*

THE CART-BEFORE-THE HORSE AUTOMOBILE.

"There's a 'cart before the horse' automobile in Baltimore that is attracting much attention, as it is designed to do, being a perambulating advertisement. A small gasoline motor, concealed under the seat, is connected with the front axle of the buggy, and furnishes enough power to not only move the buggy, but pull the horse along as well, in case he should balk or refuse to go. The vehicle is steered by a wheel fastened in front. It is merely an ordinary wheel with the rim cut off. By an ingenious scheme, the escape of steam is controlled so that only a small jet gets out from the bottom of the wagon box, and the exhaust is effectively muffled. At a distance of fifty feet it appears as if the horse were furnishing the motive power, but he is merely in the fills for ornament and not for use."

Another novel scheme recently seen in a neighboring town was a two-wheel cart, the wheels of which were made of plank, the hubs being made of cast iron, the hole through the wheel, instead of being made at right angles to the wheel, was made at an angle of about 10 degrees. When this vehicle was being drawn through the streets by a horse it made it look as though it were falling to pieces at every revolution of the wheels.

DISCUSSION.

Mr. Perkins:—I have a lot of material here which has been sent in by different members, and which can be inspected by any one who desires to look at it.

President Doherty:—Gentlemen, the subject is now before you for oral discussion. I hope you will avail yourselves of this opportunity to offer any suggestions, comments or criticisms *a propos* to this department.

C. W. Andrews:—Mr. Chairman, I know that we feel very greatly indebted to Mr. Perkins for the work which he has done in getting this department started, and for the amount of valuable material he has brought here, and the profitable suggestions he has made. I think it will be of value to all of the members of the Association. Therefore, I move you, Mr. President, that this Association tender a hearty vote of thanks to Mr. Perkins for his efforts in this direction.

The above motion, being seconded by Mr. Stone, was unanimously adopted.

Mr. Perkins:—I do not think the membership at large appreciates advertising in its fullest sense. There is a great deal of advertising in the shape of novelty advertising that is as effective or more effective than ordinary newspaper advertising and costs very little. There are many forms used by merchants and persons engaged in other lines of business which can be applied to the gas business as well as to any other kind of business. Judging by the trouble I have experienced in gathering up the suggestions contained in my report, I do not think the membership appreciates its importance or realizes all of its difficulties. The various forms of novelty advertising used in other lines of business can just as well be applied to the gas business as to the dry-goods business or the hardware business or any other line of merchants, and if this department is to be continued it ought to receive better attention than it has received in the past by each individual member of this Associaion.

Mr. Malone:—We adopted a plan at Madison recently, too late to send it to Mr. Perkins. In fact we only adopted it two or three weeks ago. We bought 5,000 toy wooden whistles at 0.6 cents a piece and distributed them among the school children. We gave a few away and it did not take very long for every kid in town to find it out. The school children each obtained one of these toy whistles and went to school. The teachers, of course, took them away. They came back and got more. Some of the children were turned out of school for their persistency in noising about the merits of artificial gas for cooking.. Of course, each whistle had stamped upon it the words, "Cook with gas," or "Buy gas stoves," or "If you love your wife, buy her a gas stove," etc. In a few days we began to get letters from our consumers saying that they were already cooking with gas and would promise to induce their neighbors to cook with gas if we would only quit giving away the whistles. The newspapers of the city also took up the subject. One paper in particular, I remember, published a letter signed "A Nervous Mother," saying, "If you will withdraw your whistles, we will all cook with gas." The jewelers and music stores were all kicking because it had stopped the sale of jews-harps and mouth-harps.

F. W. Stone:—It is my impression that street-car advertising, display signs or something of that kind is better for the gas company than the ordinary ads. we see in newspapers. I would like to hear the subject discussed along that line. We

have gone into the street-car advertising to some extent the last year and find more comments made from that form of advertising than we do from newspaper advertising. I think the cards that we have put in the street cars the last year have caused more comments than all of the newspaper advertising done for the last two or three years. It attracts more attention and you hear more remarks and comments about it. I want to call that kind of advertising to the attention of gas men wherever they can have the advantage of using it. Last month I had a card printed, "Don't dirty your hands; use gas for both cooking and heating," and I used a cut of a hand made from an impression of the printer's hand dipped in ink and pressed on a card. It was the kind of ad. that attracted the attention of everybody in the car, and it created quite a discussion as to whether it was a wood cut or whether the printer had really used his hand to make the impression. The day before I came here I presume a dozen people asked me how it was made. I simply call attention to this to suggest that I think it is a very good way of advertising.

THOMAS LITTLEHALES:—Mr. President, I have had a good deal of success in another method that has not been referred to to-day. That is, setting up cook stoves on the sidewalk and cooking anything that people would bring along, and giving notice along the street the day before that the stoves would be set up at such and such a place. I think I can safely say that in every instance where a stove was put up along a street or boulevard not less than five or six sales of stoves would be the result each time. We could calculate on going into any street we might select and selling five or six stoves as the result of setting up one on the sidewalk and cooking anything that any of the neighbors cared to bring along. We have sold a great many stoves in that way and have found it a very effective way of advertising gas stoves.

MR. LLOYD:—Mr. President, I would say that it may be a matter of some interest for the members to know that at Adrian we are using a system of general advertising which was put out by a concern in Boston—I think the Home Science Publishing Company. They furnish a little booklet which will go in an ordinary envelope, and each month, suitable to the season, there is some appropriate cut. It consists of probably eight of ten pages. We are putting out about 2,000 per month, I think, and distributing them by messenger boys. They attract the attention of the people to whom they are sent. They contain a comical cut appropriate to

the season, as, for instance, early in the fall they will take up the question of when you will make your preserves after the summer vacation, and will give some general illustration on the subject. Then they will take up the heating question and the lighting question, and each month there is something different. We have not run it long enough to find out what the effect of it will be, but judging from our experience so far, it seems to be a useful and profitable means of bringing before the people the advantages of gas for cooking or illuminating. The expense to us, I think, is about $100 for the year's service.

FRANK HESS:—Mr. President, we are advertising now to put in stoves to May 1 for $1.50 off. We sell stoves at a profit the rest of the year. It may be hard to sell stoves in some cases at the regular price after May 1. We are also using a recipe for planked fish in a book gotten out periodically, by one of the churches, which makes a very attractive and useful ad.

JOHN FRANKLIN:—We are not doing any advertising at all except sending out solicitors and making house-to-house solicitation, especially along the line of some of our new mains. These solicitors, of course, explain the advantages of the gas stove and instruct new consumers in the economical use of gas, etc. That is about all the advertising we do.

PRESIDENT DOHERTY:—Before closing the discussion on this subject, I want to say one word with reference to the importance of this department. The Novelty Advertising Department of this Association was inaugurated for all of our membership, but more particularly for a certain class. There are lots of men who want to advertise, but they cannot advertise in the usual channels because it is too expensive. They cannot get the necessary appropriation from their directors. One definition of novelty advertising might be "that form of advertising which by its novelty will attract attention without incurring any great expense," thus enabling these gas companies, without going to any great expense, to call the attention of the public generally to the merits of gas for different purposes. Now we not only want the forms of advertising of a novel nature done by the gas companies, but we also want our members to watch the advertising done by other people, and when they see any advertising of a novel and inexpensive nature done that would be applicable to the gas business, to send it in to our editor, so that our members who have not the funds to advertise in the usual way will be able to take advantage of these novel and inexpensive methods for advertising gas.

Mr. Hess:—The mode of advertising spoken of by Mr. Perkins last year of tieing samples of coke up in ribbons is a mode of advertising which we have used to great success, and I think I can trace the sale of our entire stock of coke, with the exception of two cars, to that advertisement. Our coke is not crushed. We sell it at $4 per ton delivered just as it comes from the retort.

Mr. Boyle:—In our part of the state we sell coal by the bushel; it is soft coal. I manage to get our patrons to weigh their coal in 16-inch hods, which will hold 0.5 bushel. Then I get them to compare the cost of the 16-inch hod with the cost of the gas consumed to secure the same result. Coal, as you are well aware, is generally sold by the ton, but we sell it by the bushel—9 cents a bushel—and I think that a bushel of coal will not go as far as gas costing the same amount. We sell our gas at $1.50 for illuminating and $1.25 for fuel, and $1.25 worth of coal will not go as far as $1.25 worth of gas in whatever manner it is consumed, whether by grate or range.

John D. McIlhenny:—In reference to the sale of coke, I know of one plan which has proved to be very effective—an advertisement that a barrel of coke would be delivered at your house for 25 cents. That seems cheap. Everybody knows what the size of a barrel is, and the quantity looks large and the price looks cheap. It has been found to be a most effective way of advertising.

The President:—We will now take up the discussion of the following subject, "Are loose-leaf ledgers desirable for gas company records?"

A. P. Lathrop, of St. Paul, Minn., then read the following:

LOOSE-LEAF LEDGERS FOR GAS COMPANY RECORDS.

A. P. LATHROP.

The question assigned me was: "Are Loose-Leaf Ledgers Desirable for Gas Company Records?" Assuming that the question was to apply to other records than simply ledgers, I will take up the card-system and loose-leaf ledger system generally.

The modern system of accounting in gas offices necessitates a great deal more detail than was necessary a few years since, when business was small, and one man could be depended upon to furnish all kinds of information from memory, and record books were of but little importance. Inability to take care of the extra details

necessitated by the increase of business, without adding heavily to the expense account, has probably deterred many from keeping the records which they should. From personal experience I know of nothing which has helped on these lines more than the card and loose-leaf systems.

For application blanks, meter records, stove records, street lamp service and main data, indexes, etc., the card system is especially well adapted, in many cases one card doing away with the use of two or more books. In addition to this saving, the ease with which filing work can be done and reference be made, effects a very material economy in time.

Where it is not considered advisable to use cards, loose-leaf books can frequently be used to very great advantage. The greatest objection I have heard raised to the loose-leaf ledgers has been that the leaves may be lost or wilfully destroyed, thus doing away with the permanency of the record. The question as to whether the courts would consider records kept in this manner as being reliable as would be those kept in the old-fashioned bound book has also been brought up against this system. I feel the employment of careful help will eliminate in great part any danger from the losing of leaves, and that the wilful destruction of the leaves could just as well apply to the bound books, but the ability to prove the accuracy of the records, if we were obliged to present them in court, is a very serious question, so serious that I should hesitate to recommend loose-leaf ledgers for our general books, but for petty ledgers I am much in favor of them. With them there is never the bugbear presented to bookkeepers of transferring a great number of accounts from the old ledger to the new one, nor does he have a vast amount of dead material to look through when drawing off his balance. By easy reference he has a complete record of every account with which he has any dealings, and the ledgers practically index themselves.

For the consumers' ledgers, where practically all the accounts are opened and closed monthly, I have never been able to see any advantage in using the loose-leaf system: on the contrary, it has always appeared to me as if much more time was required in keeping the records on that kind of book than on the form which has been in general use by most gas companies for many years.

Charles S. Ritter, of Detroit, Mich., then read the following on the same subject:

LOOSE-LEAF LEDGERS.

CHAS. S. RITTER.

A fairly satisfactory answer can probably be given for this question, but a more intelligent one could be given if the local conditions under which the accounting is to be done were known.

For such records as the petty ledger the matter will be readily decided by any intelligent and progressive bookkeeper.

In the case of the consumers' ledger, however, where one book is but a small part of the whole, the accounting is divided among a number of bookkeepers, and various other clerks must have access to the books, the question assumes a somewhat different aspect. Especially is it so in a large office where 50,000 or 60,000 accounts are kept, and as many as 50 or 60 clerks have access to the books.

Obviously, whatever system is used, it must be simple, easily understood and accessible.

By simplicity is meant that the printed form must be as simply and plainly arranged as possible, with due respect for the amount of labor required to record a given amount of data; and the placing of the data into its correct sequence and with proper regard for its relationship to other forms already in use or to be adopted.

It must be accessible; and by this several things are meant, viz., the ledgers must be handy to all who use them, and handiest to those who use them most; they must contain the fewest practical number of accounts in order that as many as possible of the ledgers may remain in the rack, handy for any who need to refer to them. In these respects the loose-leaf ledger has a decided advantage.

Being small it will conveniently permit two bookkeepers to work at each desk—thus requiring a minimum of floor space, and reducing distances from any part of the office to the ledger rack. By using 48-pound double bond paper, about 1,000 sheets can be carried in a 3-inch ledger. One ledger keeper can keep four ledgers, making it possible to have at all times at least three in the rack. The use of this thin bond paper is also an economy in space required and weight of books.

No indexing is necessary with the loose-leaf, as the sheets can be kept according to street and number, making the location the

unit and index to the account. By this means an account can always be found at one place, while with the old-style ledger, if the space saved for new contracts has been filled, the proper sequence of the accounts will be broken.

A moderate-sized sheet will carry accounts for four years, thus cutting out the necessity of rewriting ledgers every year, and saving all of the attendant annoyance, such as losing track of accounts, and being obliged to employ extra and inexperienced clerks to assist in the transfer. If you have an addressing machine the sheets can be printed in a very short time, reducing the troubles incident to the transfer to a minimum. As your books will run in series of four years back references are easily made, since it is not necessary to go through a different book for each year's accounting.

Perhaps the first, and apparently the most serious, objection that will be offered to the loose-leaf is the ease with which an account may be surresptitiously "dropped" or removed, either permanently or during an audit or inspection of the books. Cases of this kind have happened; in fact, the condition of the City Savings Bank of Detroit, which was recently looted by its Vice-President, was concealed from the directors and bank examiner through the removal of loose-leaf ledger sheets during the examination by directors and bank examiner. State Bank Examiner Maltz will recommend to the next meeting of the Michigan State Legislature that a law be passed prohibiting the use of loose-leaf ledgers in the banks of the state. It is true, of course, that the removal of an account is most easily accomplished with the loose-leaf ledger, but it hardly follows that the loose-leaf causes dishonesty, and it is pretty certain that any system that might be adopted would not entirely prevent it. Where there is a will to be dishonest there is usually a way. Then, too, there is the contingency that the loose leaves may be accidentally dropped or misplaced. Theoretically these are grave objections; practically, they are only remote contingencies.

A serious disadvantage of a loose-leaf system, however, is the unsatisfactory way in which footings are kept. An adding machine is necessary, and the tapes used to record amounts of gas sales and cash receipts are anything but convenient. They are cumbersome, unsightly things, not at all satisfactory to a bookkeeper who likes to see books neatly and exactly kept. These footings cannot be kept with the ledger, but must be filed separately.

The method of checking back with these tapes is also very awkward, there being nothing on the tape to indicate where or to what account an amount belongs, except that the amounts are alike, and in same sequence.

These observations, which are the result of experience with both systems, may be of service to some who are contemplating a change, and it is with this point in view that the above comparison of the two systems is submitted, simply for what it is worth.

Of course it must be understood that this comparison is very general in a way, as it must necessarily be, on account of the various different forms of both styles of ledgers, as well as other unknown conditions. Good accounting is being done with either system. In some cases a change to the loose-leaf might be an advantage; in others a consequent disturbance of the established office methods would be too great and would offset all of the advantages of a new system.

After all, bookkeeping is only "common sense." Any system of bookkeeping or style of book is as good, or as bad, as the bookkeeper makes it.

Ernest W. Bell's discussion on the same subject was then read by John D. McIlhenny, as follows:

LOOSE-LEAF LEDGERS.

ERNEST W. BELL.

Regarding the use of loose-leaf ledgers for gas companies' records and accounts, will say that in St. Louis we make use of them very extensively, and find them extremely desirable, thoroughly reliable and economical to a great degree. Bound books do not offer such perfection and satisfaction in record or accounting work that can be and is obtained with the use of loose-leaf ledgers and cards. A few disadvantages which are sometimes raised against the loose-leaf books, but which from our experience did not prove so alarming, are more than offset by the accurateness and economy gained.

In the matter of ledger leaves not standing in court, will say that even a bound ledger will not hold unless the records therein are substantiated by the original entries, and these are always on loose sheets, such as vouchers and invoices, so that objection cannot be advanced to the loose-leaf book's discredit. The matter of the leaves being lost or wilfully destroyed has not occurred to us

as being a serious objection. In fact, experience has shown us that such annoyance does not exist. However, to guard against this point, we have in the important books devised the following scheme:

All leaves are numbered and countersigned by some one in authority. They are then given to the bookkeeper, who is held accountable for them; at any call of the Auditor, Secretary or such person the bookkeeper must show the full number of leaves issued to him. The signature on each leaf will prevent any tampering with the leaves for dishonest purposes.

We find our greatest saving, for financial as well as where record and shop work is concerned, is with the use of the loose-leaf consumers' ledger. This is especially so where a great number of accounts are kept. The leaves in the ledger corrspond to the leaves of the meter route book (which is a loose leaf), and are arranged so the gas bills can be handled without resorting. This cannot be done with bound books to advantage, as the growth of the city cannot in any way be determined, and it will not be long before a bound book will have the entries all out of order.

DISCUSSION.

THE PRESIDENT:— Gentlemen, you have heard the three written discussions on the subject of loose-leaf ledgers. I do not think they are conclusive at all. Has anybody anything to add?

ERNEST F. LLOYD:—Mr. President, I have used the loose-leaf system and the card system for a number of years, and I don't think I could keep house without them. There is only one place in the gas-works in which I do not think very much of the loose-leaf system, and that is the consumers' record or register. For all other services I do not think there is anything equal to them. We use them for meter records, complaint records and orders of all characters, route books, and, in fact, for every system and department of the works, even down to the monthly records of the operation of the works, with the solitary exception I have indicated. For consumers' registers, however, I think they are too cumbersome. The nature of that record is largely in bulk, and while you wish to find the individual items of the accounts, you do not so much care about them after they have been once settled, merely so that you can refer to them. The ordinary book in which a large number of consumers appear on one page is much more convenient in arriving at the footings, and in ascertaining your output and receipts than the loose-leaf system. I

think that a combination of the two, whereby the ordinary ruled sheet having perhaps 30 to 40 consumers on a single page, in itself a loose-leaf system, is the better mode, so that you can insert extra leaves when required, but not have a single leaf for a single consumer. In that instance there is too much of it to handle. If you have 1,000 consumers you would have a 1,000-page book, and you practically handle it all every month. Now for the route book we use an independent leaf. That book is made up of sheets printed in black, for the original entries in the ledger. Those entries, of course, cover a certain space. Now then, if we get a consumer and have no room for that consumer on the regular page, we enter his name in an irregular place in the ledger upon a sheet printed in red, put in its regulation place in the book, and when the entry clerk is making up the record from the route book and runs across it he at once knows it is an irregular entry. There is no difficulty in the reference, because each line of the register is numbered, and that number is placed upon the individual leaf in the route book, so that when this red-letter leaf is struck the number is referred to, and it instantly gives the number in the register where that entry should be. It can be done very quickly, and without particular trouble. That is a notification I would suggest in the loose-leaf ledger for consumers' records, but for all other purposes there is nothing to equal the card system for facility and for getting at results promptly.

Charles S. Ritter:—In addition to what I have said in my paper I would like to recommend in the use of a deposit ledger that the old-style ledger be used on account of the importance and permanency of the accounts, some accounts lasting 10 or 15 years. It will plainly be seen that a permanent record must needs be kept, and our experience has been that it is much easier to keep it balanced by the use of the regular ledger system. We are using the card ledger at the present time, but as quickly as we can do it we are going to transfer it to the regular ledger system.

President Doherty:—Then you would recommend the regular system for deposits?

Mr. Ritter:—Yes, sir, for consumers' deposits.

President Doherty:—"How May Complaints Be Best Cared For." I will call on Mr. Andrews to read the written discussion by Mr. Frank W. Frueauff, who is not able to be present at this meeting.

Frank W. Frueauff's written discussion was then read by Mr. Andrews, as follows:

HANDLING COMPLAINTS.

FRANK W. FRUEAUFF.

The success and permanence of a gas company depends, in a large measure, on the feeling of the public toward it. That this feeling be one of interest, and so far as possible friendship, requires constant watching and the utmost care. Most of the ill feeling against a company is shown in the complaints received at the office, and here must the work of reform be carried on. Prompt and careful attention given each complaint will soon show results and make many friends out of former dissatisfied consumers.

A systematic handling of this branch of the business is absolutely necessary. Otherwise trouble will result from loose methods of receiving the complaints and failure to attend to them promptly. If a consumer reports trouble at the office to the first clerk he sees, who in turn refers it to another clerk, or intends to do so and neglects it, confusion as to the cause of trouble often occurs. The wrong man is sent, or goes at an inconvenient time, or fails to take with him the proper tools, and not infrequently no more attention is given the order. No one can be found who took the order and no one can be held responsible for the neglect. The consumer gets out of patience with such carelessness and tells it around to our harm and discredit.

The method adopted in Denver, and now in successful operation, is briefly as follows: All reports of trouble, dissatisfaction or misunderstanding are received at one window by a clerk whose business it is to make a personal matter of each report and follow it to a satisfactory end. He is also provided with telephone connection, so that all reports come direct to him. As the reports are received they are entered in a book which is ruled with headings as follows: Order number, name and address, time of receipt of order, and under a heading "nature of complaint," the following sub-headings: Leak, poor light, no light, high bill, set complaint meter, adjust stove, adjust heater, put up pipe, complaint regarding employe, miscellaneous complaints; also heading, attended to by, date, remarks. The complaint being received and understood thoroughly by the clerk, he makes out an order

covering the facts as entered on the book. This order is given to the proper employe who executes it as promptly and carefully as possible, reporting on the back of the order the time the order was executed, what was done, or what facts he learned in investigating the complaint. When he has completed his work the order is returned to the clerk, who examines same and enters the record opposite the order in his book, then filing it numerically for future reference. He then makes out and sends to the consumer a return postal card reading as follows: "On ——— date, you reported ——— (here filling in the complaint shown on his book). Kindly fill out the return postal card stating whether everything has been done to your satisfaction. Your prompt reply will be appreciated. Yours truly, The Denver Gas and Electric Company." On the return portion of the card is marked the number of the order for convenience in checking when returned.

This last feature, the return postal, has proven most successful, and has occasioned many complimentary remarks from our consumers. It has accomplished a two-fold purpose. First, it enables us to know that the consumer has been attended to properly and is satisfied with the work done, and again is a check on our employes. We have found but few cases where they had to be sent back again to complete or change their work, their knowing that the consumer was expected to advise the office after completion of the order stimulating them to better efforts.

These comparisons show the results of one month as compiled from postals returned: Postals returned to office, 48 per cent. This is accounted for by the fact that many people do not bother to report back to the office when the work is satisfactorily done. We feel if it were not properly done they would take this means of advising us. Of those returned 79 per cent. reported everything O. K., and 62 per cent. added thanks for the interest shown. Thirteen per cent. reporting back said work was not done satisfactorily. In these cases the original order was taken out and the employe notified of the second complaint and sent again to remedy it. After this was done a second postal was sent to insure a satisfactory job. Eight per cent. of those reporting back stated that the trouble complained of was executed satisfactorily, but that they wanted to report other trouble. These orders were received and executed as original orders.

We have been able through this means to locate most of our dissatisfied consumers and attend to their wants, and the beneficial results accomplished are most gratifying.

M. E. Malone, of Madison, Wis., then read his written discussion on the same subject, as follows:

HANDLING COMPLAINTS.

M. E. MALONE.

In giving my views on the subject of how may complaints be best cared for, which Mr. Frueauff has so ably discussed, I desire to heartily indorse each and every one of the statements contained in his paper, as they bring up for consideration in a most concise manner a subject that is of the utmost importance to the management of a gas company.

Perhaps the briefest manner in which I can best express my views on this subject is to give a short synopsis of our practice at Madison, and although it embraces many of the best points of that vogue in Denver, there are some features quite different and perhaps worthy of consideration.

During 1896 we were impressed with the importance of having some regular method for handling complaints, and although the mtehod first adopted was rather crude, it has been gradually improved upon until now it is entirely satisfactory.

A "complaint clerk" is stationed at a desk near the entrance to the office where complaints of every description for both the gas and electric departments are received and entered in the proper complaint book, there being a separate complaint book for each department, no employe other than the "complaint clerk" being allowed to receive or enter complaints.

Our complaint books are specially ruled, the year and month being written at top of page, while the day of the month is written to the left of each order, where each consecutive number is stamped with a Bates numbering machine. Four lines are allotted for each order, and sufficient space is allowed on the right for enterting the written report turned in by the fitter after complaint is attended to, thus giving us the record in one place of the entire transaction. By numbering orders consecutively, you can tell almost at a glance the number of complaints received daily, monthly, or for the entire year.

When a complaint is brought to the office, the person bringing same is directed to the "complaint clerk," who is thus enabled to get the exact nature of the trouble and enter it accordingly. For instance, if party filing the complaint says: "There is something

wrong with our gas stove," it is the duty of the "complaint clerk" to ascertain as nearly as possible what that "something" is—it may be a leak, the oven may not bake properly, or one of the burners may be out of order. Thus it is essential to get the order correct so that the fitter sent to remedy it can proceed in an intelligent manner. All telephone calls are answered by the "complaint clerk," who can thus get complaint orders direct that are sent in this manner.

The "complaint clerk" is held accountable for the proper execution of every complaint received, and issues orders in writing to the different fitters or trouble men. The "complaint clerk" has an assistant who enters all orders received during the evening and at meal hours, but does not issue orders unless it is imperative from the nature of the complaint that it be attended to at once. A written order is issued to complaint clerk for every complaint received, and he is required to report in writing how complaint was remedied and what more, if anything, is required, and sign his name to order before turning it in.

We have an inspection made twice a year, each spring and fall, of every main and service trench opened during the previous year, and where settlements and other repairs are found necessary, an order is issued to the superintendent of distribution to have the same attended to at once. We also have an understanding with the city's street superintendent that he will confer a favor on us if he will report to us any trouble found where our company has made excavations. In this manner we not only avoid any friction with the residents or city authorities, but the fact of the case is, we receive the highest praise from all sides for the manner in which we repair our trenches, thus preserving as far as possible the streets or our beautiful city.

We recommend the use of a bicycle for complaint men, as we find it cheaper than a horse and wagon or paying street-car fare. One of our complaint men kept track of the distance traveled during the year 1900 by the use of a cyclometer, which indicated he covered a distance of 3,070 miles, or about 10 miles daily, counting 300 working days to the year. This distance was not put in entirely on complaints, however, as it included other work, and the going to and coming from his home at meal times, etc.

During 1901 we received and attended to the following complaints:

Welsbach lamps	554
Freeze-ups	126
Miscellaneous	2,216
Total	2,896

or an average of 9.5 complaints daily, leaving out holidays and Sundays. These complaints did not require the entire time of one man each day.

The return postal card feature which Mr. Freuauff recommends so highly has been in use by our company during the past three years, and it has proved conclusively to be the best feature of our entire method.

In conclusion would state that our experience at Madison during the past six years has demonstrated beyond a doubt that the adoption of systematic methods for handling complaints (whether they be real or imaginary ones) is absolutely necessary in order to obtain the best results, and we firmly believe that the cost in dollars and cents will bring a larger return than double the amount invested in any other manner, and at the same time insure the good will of the public to a great extent.

DISCUSSION.

CHARLES S. RITTER:—Mr. President, I think there is nothing in either of these papers covering the method of filing complaints. In Detroit we keep our complaints, you might say, on a loose leaf, as it is received by the complaint clerk, and on the reverse side is the report of the man who does the work. This complaint is filed according to the street and number, and all additional complaints for the ensuing year will be filed along with it. At any time the complaint clerk receives a complaint she can turn to this file, which is very handy, and take out all the previous complaints, and if she finds that the trouble is the same each time, of course, then it is up to the distribution department to remedy the trouble, whatever it may be.

PRESIDENT DOHERTY:—The point which Mr. Ritter mentions is very important, especially in a large gas company. Below a certain size town you can keep track of the complaints with but little difficulty, but above a certain size it is never safe to depend

upon remembering them. Has any one else anything to add upon this subject? I consider it one of the most important subjects a gas company has to consider.

J. H. MAXON:—Mr. President, we have used slips that were perforated through the middle, with a proper heading, and the fitter attending to the complaint would write his name on the top of the slip and tear off the bottom portion and return it with the report of the work done. Both the top and bottom portions of the slips are numbered consecutively and filed in this way, and the unattended complaints kept on a stick, so that they are continuously before the fitter to show how many unattended complaints there were and when attended to, and are filed as per number. We have found that having them in that shape is better than the return on the back, as you do not have to turn them over to see what the report is.

ERNEST F. LLOYD:—We have a system of handling complaints at Adrian which has been in use only for about four months now, and is giving excellent results. I think there is no question about the necessity of giving all complaints immediate and thorough attention. We use a card of the standard size, 3 x 5, and these cards are numbered, repeating each 1,000 cards. The number is used only for the execution of the work. These cards are in bunches on the desk. When a complaint comes in, the name and address of the party and the complaint is entered on this card; also the time when it is received and by whom it is received, and to whom it was issued for execution, with the time, and the time of the return to it. That card does not leave the office. We want it for a permanent record. A manila duplicate is issued to the fitter. That duplicate bears the name and address of the complainant and the trouble reported. After it is returned the man puts in the amount of time he has spent on the complaint and whatever may be used in the way of material, and the entry is made from this manila duplicate, which is usually considerably soiled, on to the permanent card. Then a postal card is sent to the consumer notifying him of what has been done and asking if he will communicate whether there is anything further required in the matter. The name of the fitter is put on the postal card by way of fixing responsibility, making him feel a certain amount of personal interest in it, or personal fear in it, as you choose.

On the back of that card we enter up the name of the man, the amount of time put in on the work and the value of the material. It frequently happens that a complaint is not merely something that you have to remedy at your own expense, but he may

put up mantles and various things, and from this card any charge is made out against the consumer and billed to him. After that, the number which was used on the card originally is disregarded, and these cards are filed alphabetically. As a result, you have all

COMPLAINT NO 1 1000	NAME
RECEIVED HOUR M.	ADDRESS
ISSUED HOUR M.	COMPLAINT
RETURNED	
RECEIVED BY	
ISSUED TO	
CAUSE AND HOW REMEDIED AND RECOMMENDATIONS.	
	Postal LIBRARY BUREAU, CHICAGO

Front.

LABOR				MATERIALS	
NAME	HOURS	RATE	AMOUNT	ITEMS	AMOUNT
CHARGED				CHARGED	

Reverse.

COMPLAINT RECORD CARD.

complaints from any one party all together over a series of years, and, as was remarked a few minutes ago, it is more important in a large company than in a small one, but we find in a town of

30,000 people it is very useful to have a written report of the complaints received from any one source, and we are able to remedy such things as trouble in the service, if we find that trouble is frequently reported, causing stoppage or otherwise, which will be shown by the accumulation of cards against a single individual. In that way we are able to locate the source of the trouble by relaying the service or protecting it at some exposed point. During the past winter we found this to be a very useful feature. In that way we are able to keep track of the labor and material used with very little expense, and it is done by a $3 or $4 clerk in the office. We have a young lady who attends to it, the cards usually passing under the eye of the manager, so that he may give any special directions that he may desire. If materials are used in the remedying of the complaint, they may be charged up to distribution and credited to merchandise account. If they are to be billed they are charged to the consumer and credited to merchandise account, and in that way we are able to keep track of our merchandise account and apportion our charges properly for the various expenditures in the different departments.

The form of complaint card we use may be interesting. They are standard library cards printed in black. Our complaint cards are numbered from 1,000 to 1,999 in red ink, the first 1,000 having a "1" in the upper left-hand corner; from 1001 to 2,001 a "2" etc. The number in red is the only one the workmen observe in reporting time and material. After the work is done and the complaint satisfied, the card is filed, either by number or location, as desired. After this the following form on a postal card is filed out and mailed to the consumer:

Adrian, Mich.,...............190

M.................................

Our Mr....................reports that he called your..............yesterday in response to your order (our No.........) and that he......................

..

If there is cause for further complaint, please notify us at once, as we desire to have everything done to your satisfaction. Very respectfully,

(Use Gas for Light and Fuel.) *ADRIAN GAS COMPANY.*

POSTAL ANNOUNCING THAT COMPLAINT IS ATTENDED TO.

A. P. LATHROP:—I think the suggestions which Mr. Lloyd has made are very good, but I like the idea of filing these complaints away by street and number, rather than by indivual names. I think it is better, because most of the trouble comes, not from the individual, but from the location, and having them filed that way, you can the more easily locate and remedy the trouble.

John Franklin, being called on by the President, said: I do not know that I can add anything to what we have already listened to, with the exception of stating the system in vogue in Cincinnati. When we receive complaints they are recorded on a ledger, and from that ledger the slips are made out, of leaks, stoppages, or whatever complaint may be. The slips are given to the men, and each man as he goes out has tools with him which are numbered, with a seal, so that he can seal each meter, and when he leaves, he leaves a record behind him. In that way, we know just where to place our hands on the man who did the work, and ascertain exactly what was done. Then those complaints are filed away according to location. We have a lock-meter connection and that is sealed by the complaint man. The seal is a lead bullet compressed by a tool and sealed, showing the name of the company and the number of the complaint man.

On motion, duly seconded, the Association then adjourned until 2 P. M. of the same day.

FIRST DAY.—AFTERNOON SESSION.

The Association met at 2 P. M.

PRESIDENT DOHERTY:—Mr. S. J. Glass, of Milwaukee, Wis., makes a contribution to the discussion on loose-leaf ledgers. I will read it.

DESIRABILITY OF GAS COMPANIES USING LOOSE-LEAF LEDGERS.

S. J. GLASS.

The question assigned me was, "Are Loose-Leaf Ledgers Desirable for Gas-Company Records?" Assuming that the question was to apply to other records than simply ledgers, I will take up the card system and loose-leaf ledger system generally.

The modern system of accounting in gas offices necessitates a great deal more detail than was necessary a few years since, when

business was small and one man could be depended upon to furnish all kinds of information from memory, and record books were of but little importance. Inability to take care of the extra detail necessitated by the increase of business without adding heavily to the expense account has probably deterred many from keeping the records which they should. From personal experience I know of nothing which has helped on these lines more than the card and loose-leaf systems.

For application blanks, meter records, stove records, street lamp, service and main data, indexes, etc., the card system is especially well adapted, in many cases one card doing away with the use of two or more books. In addition to this saving, the ease with which filing work can be done and reference be made effects a very material economy in time.

Where it is not considered advisable to use cards, loose-leaf books can frequently be used to very great advantage. The greatest objection I have heard raised to the loose-leaf ledgers has been that the leaves may be lost or wilfully destroyed, thus doing away with the permanency of the record. The question as to whether the Courts would consider records kept in this manner as being as reliable as would be those kept in the old-fashioned bound book has also been brought up against this system. I feel the employment of careful help will eliminate in great part any danger from the losing of leaves and that the wilful destruction of the leaves could just as well apply to the bound books, but the ability to prove the accuracy of the records if we were obliged to present them in Court, is a very serious question, so serious that I should hesitate to recommend those loose-leaf ledgers for our general books, but for petty ledgers, I am much in favor of them. With them there is never the bug-bear presented to the bookkeepers of transferring a great number of accounts from the old ledger to the new one, nor does he have a vast amount of dead material to look through when drawing off his balance. By easy reference he has a complete record of every account with which he has any dealings and the ledgers practically index themselves.

For the consumers' ledgers, where practically all the accounts are opened and closed monthly, I have never been able to see any advantage in using the loose-leaf system, on the contrary it has always appeared to me as if much more time was required in keeping the records on that kind of a book than on the form which has been in general use by most gas companies for many years.

PRESIDENT DOHERTY:—If there is no discussion or comments to be offered in addition to what has already been said, we will take up the next order of business, the discussion of "Coke Handling," by K. M. Mitchell and Irvin Butterworth.

COKE HANDLING.

K. M. MITCHELL.

In our Text Books on Gas Manufacture, much is said about the working up of the residuals, coal-tar and ammoniacal liquor, but very little of the most valuable of them all, namely, coke.

Each manager must decide for himself how he may best dispose of this product. Very little is done comparatively toward making a market for it in his own city. As a rule, he defers action until every available spot in the gas yard is covered with mountains of coke, then we find him shipping his product to some other market, and at a cut price.

The writer believes that every bushel of coke made in gas retorts of a city gas-works can be sold in the market of the city where it is produced.

The question is asked, What price shall we demand for our coke? The reply would be, the situation governs the price. It depends upon the cost of other fuels. Lump coke should bring one dollar and fifty cents per ton more than soft coal. Egg and nut, a little less than anthracite.

I cannot do better than give you a history of our experience in handling coke in St. Joseph, Missouri, where for seventeen years (except the past year) we have never carried over a ton of coke from one season to the other.

Years ago, when we were about to establish a system of regenerative furnaces, I was explaining to one of our directors how we would make more gas per bench and save more coke. He thought the making of gas all right; but suggested that we put in a furnace that would consume the coke, as we had such a supply on hand. My reply to this was, we will crush the coke and sell it in the local market, and that I felt confident we could work up a good trade (the company before us had consumed all the coke they had made, and the general public did not know what gas-house coke meant). We purchased a crusher and put it on top of the coke shed, and elevated the coke into hopper of crusher, by means of iron buckets attached to belt elevator.

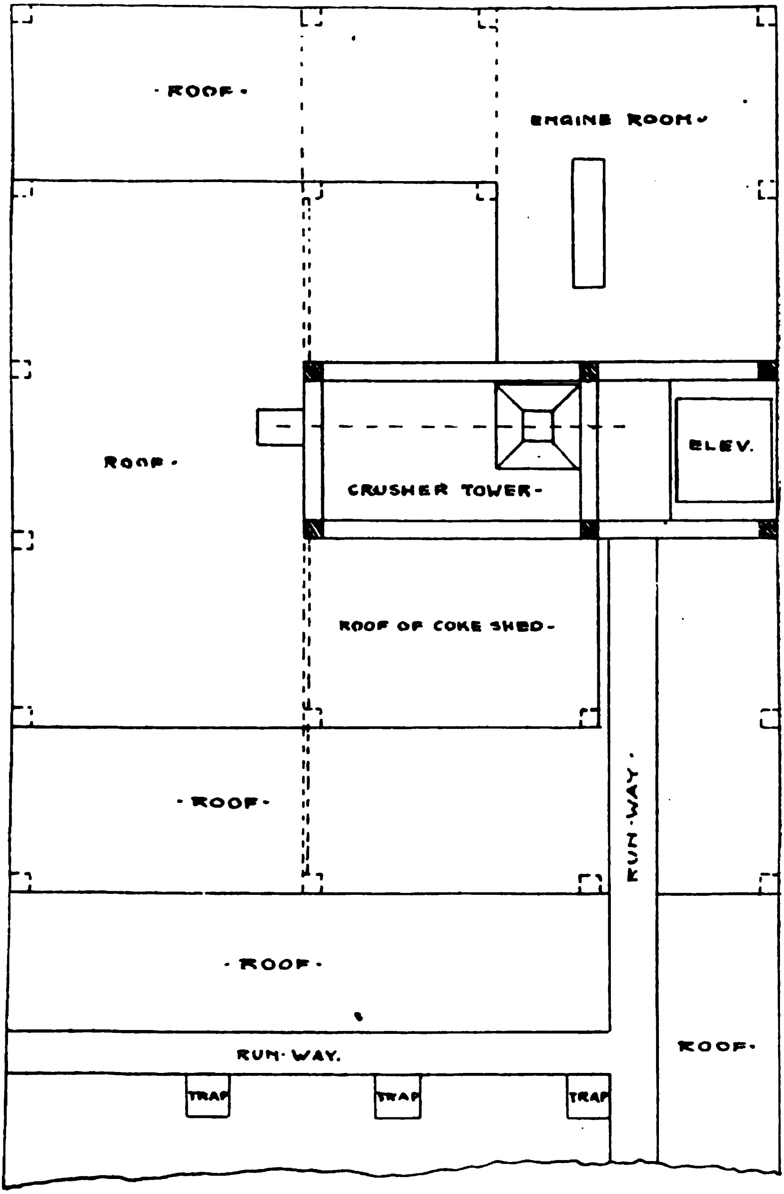


FIG. I. PLAN SHOWING LOCATION OF CRUSHER TOWER.

The crushed coke, as it comes from the crusher, fell on stationary screens placed at the proper incline.

We make what we call nut, egg and pea coke.

We found elevating the coke by means of belt and buckets was unsatisfactory on account of the wear and tear, and occasional choking up of the hopper.

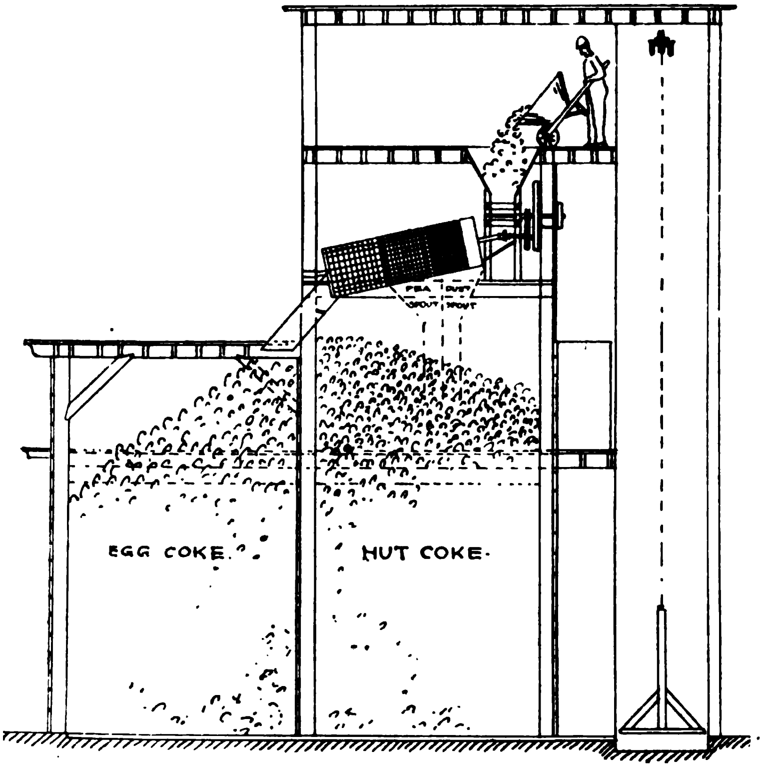


FIG. II. SECTION THROUGH CRUSHER AND SCREEN.

We then arranged the system we now have in use—See Fig. II. The crusher is placed at a height of about forty feet, and operated by a small steam engine placed in the top of tower, and connected by a chain belting to crusher. As the coke is crushed, it is directed into the end of a circular revolving screen. The screen is arranged for dust, pea and nut coke. The egg size

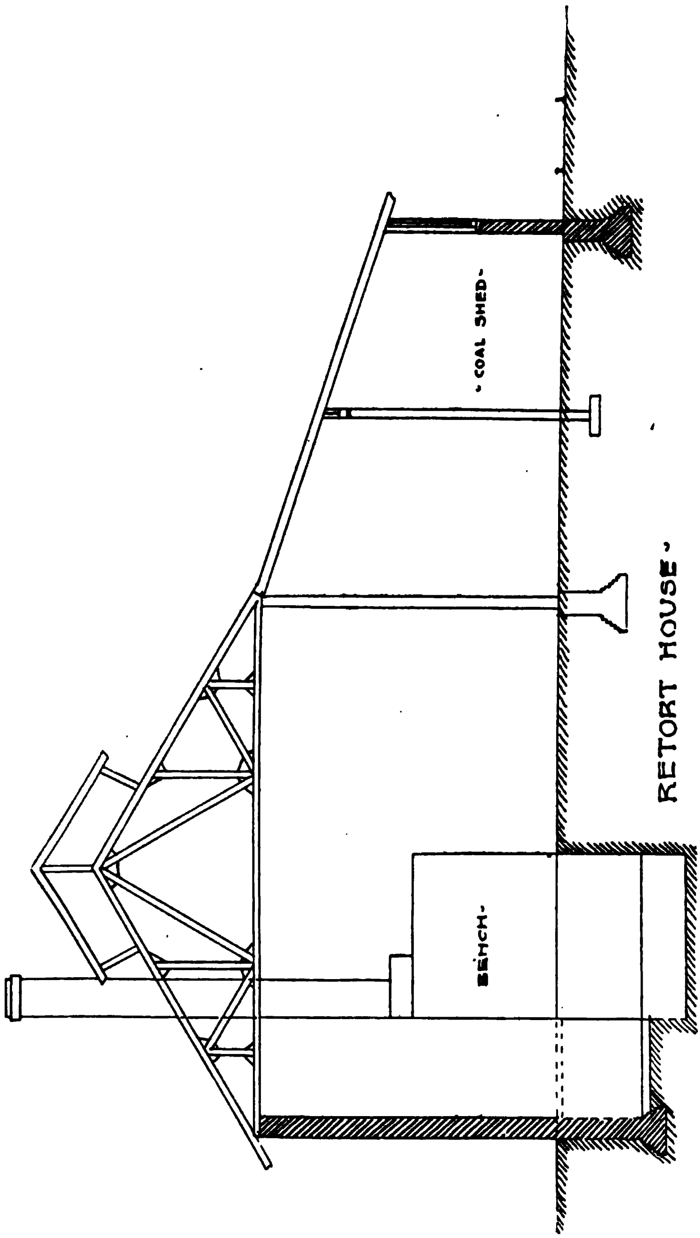


FIG. III. SHEDS FOR COAL AND COKE.

passes out of the end of the screen, where it falls into bins prepared for it, and the other sizes of coke. We deposit the lump coke in the coke shed, wheeling it out on board runways, until the pile gets too high for convenient wheeling. We then use the elevator and raise the coke to the height of the roof, where various runways are prepared leading to several openings in the roof, where the coke is dumped upon the pile built up from below. We try not to have coke fall from a greater height than necessary, so as to guard against breaking it.

When the coke is quenched as it comes from the retorts, we use as little water as possible in order to avoid water soaking.

As far as possible we keep our coke under sheds. Moisture deteriorates and slacks it.

Dry coke is more salable.

Our experience is that coke must be crushed into two sizes, nut and egg. The nut is used in medium and small-sized base-burning and cook stoves: the egg in large base-burning and soft coal stoves and grates; lump coke is used in large soft coal stoves, house furnaces, bakeries, laundries, confectionaries and upright steam boilers. Great quantities are used in the furnaces of brick kilns for water-smoking or drying the brick; the coke taking the place of wood.

Cost of crushing and elevating one ton or 50 bushels of coke:

50 bushels of lump coke at 8c. per bushel (40 lbs.)....		$4 00
Produced 22 bushels nut coke at 11c..........	$2 42	
Produced 22 bushels of egg coke at 9c........	1 98	
Produced 2 bushels of pea coke at 8c........	16	
	$4 56	
Cost of elevating and crushing	50	
		4 06
	$4 06	
Gain		$0 06

The coke wheeler starts and stops the engine which operates the crusher.

We must depend principally upon the domestic use of coke for its disposal, and this branch of our business must be managed by every legitimate means. We have found judicious newspaper advertising advantageous, also sending out dodgers during the winter season. We pay special attention to coke orders, and give

prompt and careful delivery. We have the reputation of having polite and obliging teamsters, and this we find helps largely in selling coke. If we have a customer that does not understand the use of coke, we send our experienced man to start the fire. We are also asked to advise proper stoves in which to burn coke. We select a stove that will use egg coke. A good coke stove must be attractive in appearance, reasonably cheap; must be air tight at bottom so as to hold fire.

The question is often asked, Will coke keep fire over night? The fire bowl must be large and deep enough to hold a scuttle of coke. A large door at the side above the fire box must be provided, a shaking grate and poker hole on a level with top of grate (if coke contains clinkers). The fire-box lining should be made in sections so as to be easily replaced. This stove takes the place of a base burning anthracite and soft coal stove. It has the qualities of a base burner, in that it holds fire a long time, and is equally as clean. The advantages of coke over soft coal are so evident and so numerous that it is not necessary to mention them.

We cannot be too emphatic in our praises of our product, for in it we have the most valuable domestic fuel on the market and we should never be ashamed to speak of it as such.

Prepare your coke, advertise, solicit the business in the same manner that we see other merchants doing, and I know from personal experience that you will dispose of your product at good prices and show a very handsome increase in your dividends at the end of the year.

COKE HANDLING.

IRVIN BUTTERWORTH.

I can take issue with Mr. Mitchell on only one of his statements, namely, "that every bushel of coke made in gas retorts of a city gas-works can be sold in the market of the city where it is produced." This is hardly true of those cities that are abundantly supplied with cheap natural gas.

Mr. Mitchell's opinions and experiences are extremely valuable, and his success in developing an excellent market for his coke in St. Joseph, Mo., should stimulate other companies to reach the goal of prices mentioned by him, namely: Lump coke, $1.50 per ton more than soft coal, egg and nut a little less than anthracite. By carefully preparing our coke for sale in various

assorted sizes, keeping it clean and dry, delivering promptly by courteous drivers, showing the inexperienced how to use coke, in fact by looking closely after every detail entering into the cultivation of the business, it is absolutely astonishing what a large and profitable coke market can be developed in any city. Even those companies that are at present making the best records in this branch of our business could do still better if they should try harder.

Of course in this as in almost every other department of our business, local conditions must necessarily more or less govern our methods. For instance, in some cities and with some qualities of coke, a crusher might not be necessary to the realizing of the largest possible profit from the coke, and a screen may be advantageously used instead. In Denver, for instance, our coke is rather soft and easily broken, and thus far we have been able to supply the demand for nut-sized coke by simply screening all our breeze by means of a shaking screen operated by an electric motor. As we build up a greater demand for nut coke, we can probably increase our supply of this size by also screening a portion of our coke just as it comes from the retorts. In Milwaukee and other cities, all the coke is screened, and no crusher, I believe, is used. I am inclined to think that this is a good plan, as a crusher always increases the production of dust and fine screenings, which means an additional loss. From our experience in Denver, I am also inclined to believe that a shaking screen is more economical and satisfactory than are revolving screens.

A concise and conservative rule might be something like this: Ascertain the probable proportions of the different sizes of coke demanded by, or susceptible of being most profitably marketed in your city, and use a screen for separating these various sizes. If screening all your coke should not produce a sufficient proportion of small sizes, then supplement the screen by crushing a portion of the coke to the sizes required.

An ideal coke plant, and probably the most profitable one, would be one in which the coke would be stored dry and clean in carefully assorted sizes in overhead bins from which it could be quickly loaded into delivery wagons by gravity. The delivery of water, ice, snow and dirt with coke, is to say the least, a very unprofitable and short-sighted policy. I am of the opinion that in almost every instance we can obtain the maximum profits from our coke by retaining it ourselves rather than by selling our entire production to a contractor or dealer.

In Denver, in addition to the usual methods of soliciting and advertising, we have made arrangements by which the various branch offices of the American District Telegraph Company throughout the city, where our gas bills are payable under the plan now generally in vogue, are also allowed liberal commissions for taking coke orders, each office being equipped with a brilliantly painted box composed of compartments containing the various sizes of coke, each properly labeled.

The larger companies can well afford to delegate a suitable man who shall devote his entire time to the development and management of their coke business. This we are doing in Denver with the result that we are netting 75 cents per ton more for our coke than we did a year ago. Our man makes it a point not to have a single dissatisfied coke-consumer on his books. Every complaint is adjusted to the entire satisfaction of the customer at whatever cost, in reason, to the Company.

DISCUSSION.

MR. WHYSALL:—Mr. President and Gentlemen, I agree heartily with Mr. Butterworth in his statement that it is necessary to adapt the different sizes to the paricular uses for which they are intended. Coke of any size will burn in a stove if given a sufficient amount of draft, but the degree of success attending its use depends wholly upon its size. For instance, for a base-burning, hard-coal stove you can use pea coke and get excellent results, but coke of a larger size will give better results, while egg size coke, especially in a small stove, will give very poor results.

THE PRESIDENT:—Mr. Whysall, don't you think it is as important a feature in increasing our earnings to attend to the coke business as any other branch of the business?

MR. WHYSALL:—I think that is the weak point with a majority of the gas companies.

MR. JONES:—I would like to ask Mr. Whysall if he finds a local market for the large output of coke at Hamilton?

MR. WHYSALL:—We have no difficulty whatever in disposing of our entire output, the bulk of which is sold for foundry purposes, however. The demand for domestic coke far exceeds the supply. In fact, we are unable to look at that business at all. We are producing about 200 tons per day. The population of Hamilton is about 26,000 inhabitants. A large percentage of this coke is sold for foundry purposes. Although some of it is sold in the

surrounding towns, in fact the larger portion of it is sold outside of the city of Hamilton, except our domestic coke. Most of our domestic coke is used in town.

PRESIDENT DOHERTY:—Mr. Miller, do you sell all of your coke locally in Cincinnati?

MR. MILLER:—We sell it all locally, but the contractor does not. Nearly half if it is sold out of the city.

PRESIDENT DOHERTY:—We will now take up the discussion of the "Best Way to Extend Gas Mains," by John Franklin, of Cincinnati, and B. W. Perkins, of South Bend, Ind.

BEST WAY TO EXTEND GAS MAINS.

JOHN FRANKLIN.

Replying to the request of your worthy Secretary to add my mite of personal knowledge regarding the subjects in hand, I will endeavor as briefly as possible, with the limited space of time I have, to answer the above question as completely as possible, to the best of my ability under the existing circumstances.

During the closing year of the nineteenth century it was my pleasure to formulate plans and superintend the extension of 168,000 feet of mains and services to and throughout five suburban villages surrounding the city of Cincinnati. Three of these villages were lighted and equipped with Boulevard incandescent gas lamps. In the other two, mains were extended for private consumption only, said villages being lighted by electricity. The following data will explain the system of introducing and extending mains and services to and throughout suburban villages.

The first and very important part is to take a careful bird's-eye view of the contemplated surroundings, not overlooking the main feature—"that of future development." Then interest the resident property owners and tenants by a personal introduction to them; urging them to interest themselves as much as possible to bring to bear all the influence they can in urging the Village Council to action regarding the granting of a franchise to a reliable gas company, for laying of mains, erection of lamp-posts "fitted with Boulevard incandescent gas lamps," and the extending of services for supplying the public with that ever-ready commodity, lighting, cooking and labor-saving gas.

This may appear comparatively easy, but you will find at times overwhelming obstacles, which you will meet from time to time

before you reach the desired goal. Don't give up the fight! But follow closely the line of thought which the following message reveals:

"Perserverance, backed by nerve, and a will that cannot swerve,
Will succeed though steep may be the hill you climb;
If you are seeking for a name, throw your heart into the game,
And you're bound to be a winner every time.
Keep your nervy fires alight! push ahead with all your might!
Toss a laugh to every care that meets your eye,
Whistle up a merry song as you slowly plod along,
And you're bound to reach the summit bye and bye."

If success crowns your efforts then you are thrown entirely on your own resources to complete to a successful end the furnishing of gas for lighting and domestic purposes.

Preliminary Work.—Arrange for a general systematic survey of the contemplated territory and its surroundings; plotting on map 200 feet per inch, showing the avenues, streets, byways and resident property, designating the houses along each thoroughfare. Make a careful observation as to the class of residents, and probable consumption of gas that would be used by them for lighting and heating purposes, also looking ahead for future development. Calculate for the size of mains and main feeders that would be necessary for the immediate and future demand. Then make arrangements by plotting in a small journal each street, designating the houses between intersections, also leaving the opposite page for the names of owners, tenants, agents and necessary remarks regarding their definite answer either for or against becoming a consumer.

Arrange to get a good, wide-awake, energetic young man, one of good personal address and appearance, having sufficient knowledge of the general routine of the gas business regarding the cost of piping houses, alterations and extensions, approximate cost of ordinary fixtures, gas stoves and general run of gas appliances, their utility and probable consumption and cost per month, as also cost of extending the service from the curb line of the street to the meter, and a hundred and one questions regarding the general run of the business.

Furnish your solicitor with application blanks to be signed for the insertion of a service, by the owner or agent of the property.

Also have him leave on the premises a blank application to be signed by the parties wishing to use gas, leaving also rules and regulations of the company. Inquire at this time the name of owner and tenant, and then make note of it on opposite page of the platting book designated for this purpose. By the time your solicitor has visited every house in the village, and left the blank applications with the accompanying rules and regulations, he then retraces his steps, commencing at the first house he visited, gathers up the applications, making note of those that have signed, and those that have not, finding out the particular objections of those not signing. By the time you have gone over the territory a second time start out for the third time to override the objections, bringing into play all the persuasive eloquence you may be gifted with to gather up the remaining fruit of your labors, remembering that the results gained are the keystone to your future success, which is clearly portrayed by the fact that just as soon as you get the majority of the residents' signatures, the remainder follow like a flock of sheep behind their leader. After the solicitor looks back over his field and feels positive that he has gathered up all the available timber, then his records should be turned over to the Superintendent of Distribution for analysis. Then start him out for fresh fields to conquer. After the superintendent has carefully weighed and considered the conditions regarding the investment, number of feet of main required, size of his main feeders, as also the size of lateral connections, in conjunction with the number of signed applications to the amount of main pipe required, "allowing," provided the village is to be lighted with gas, 125 to 150 feet apart to a consumer. If you are not lighting the village, allow from 75 to 100 feet of main to each consumer, unless otherwise stipulated in the ordinance.

After it is definitely settled to extend the mains to supply a certain village, the pipe, fittings, drip boxes and lamp-posts are then ordered, accompanied by a plat giving directions when and where to deliver them, designating on which side of the street the pipe is to be delivered, and which way the pipe is to be placed. This is done in order that the teamster delivering the pipe will lay the pipe on the opposite side of the street from that in which the main is to be extended, hubs of pipe facing in the same direction in which the pipe is to be laid. This saves considerable time and labor in handling when ready to extend. By laying pipe on the opposite side of the street saves tramping over the metal

thrown from the first course of excavation made, thereby preventing the metal being scattered throughout the trench. After the main pipe and fittings have been delivered, order out your service pipe, lead, yarn, coal, rubber bags, bladders, lead kettle, service cocks and street boxes. When ready to start, gather together your mechanics, yarners, calkers, joiners and laborers and prepare to forge ahead to a finish.

Trenches.—Before opening trenches take minute bearings for your levels, water-mains, sewers, crossings and other obstructions, avoiding as much as possible the aforesaid, endeavoring at the same time to lay your main on the side that is most improved, to avoid crossing for house-service connections. This occurs only when you find it does not justify you to lay main on both sides of the street.

Stretch out your street lines, allowing about three feet between center of trench to curb line. If you are going to lay considerable main, say 4, 6 or 12 inches, fifty laborers, two pipe handlers in trench, one yarner, four calkers, one lead joiner, and one blocking man will be sufficient to start your laborers. Be prompt in starting on time as this is a very essential point. Make out tracing line for a distance, say 600 feet, holding your best men at the rear. After you have given lines for width of trench laid out, start your men taking off the first metal, placing said material next to curb on the side on which you are laying your main. After all the metal has been removed, start to excavate, throwing the earth on the outside or opposite line of the trench. Give each man a section 12 feet long, two feet wide and 3.5 feet deep. As fast as they get a section cut down to the grade line move them forward. In this way ("providing the digging is fair") each man can cut out three sections for a day's work of 10 hours, which at that rate would be 1,800 feet a day. Note carefully when you are down to about the required depth; take your levels at bottom of trench so that your grade of trench bottom will conform to grade of main to be laid. This insures your pipe being laid for its full length on a good solid foundation, thereby requiring but little blocking to bring it to the grade line, also allowing no chance to trap or break by weight of traffic. In cutting out for calking room, be careful to block up your spigot ends.

By placing your best laborers in the rear, it allows you to begin the work of laying the main much sooner than if you had to wait

until the entire trench was down to grade. After pipe is laid, leveled, lined, calked, blocked and tested, start your men that are probably cutting out their second or last section in front, back to the rear to fill in the trenches, retaining your best men cutting out sections in front. Fill in your trenches to a depth of 12 inches, then turn your water into the trench and keep filling in trench. This will cause the material to be thoroughly carried under the entire line of the pipe and fill up any recesses that may have been opened out. While flushing, have six or seven men go forward and back with bars, opening up flushing holes so as to allow the water to seep through and follow closely the line of pipe, carrying with it the lose dirt and depositing it around the pipe. Fill up your trench, until the back filling is even with top of trench, then shut off the water and allow the trench to stand over night. The following morning, if the trench has thoroughly settled, fill in again as much as you can, using your rammer. Tamp well and then fill up within 4 inches of the top. Then throw in your macadam and continue tamping as you go along. By the time you are about through, you will find but a small amount of material left on the street to be carted away. If there happens to be no water, fill your trench gradually, tamping every particle of material thrown in. This will not insure as good results as flushing, it proving at times necessary to refill and retamp in some places along the line.

Laying Mains.—In the introduction of mains into new territory, when you commence, start from a given point as near to your live feeder as possible to allow you (when the final connection is made) to connect the mains with spigot ends facing each other, using a sleeve to make final connection. Do not attempt to cover a territory with mains with connections made to main live line, for the reason that if you are extending as feeders 12-inch or 16-inch pipe, you are liable to incur serious accident, as it is almost impossible to keep your line entirely free of gas, which will escape at times around your bags; not only that, but there is a possibility of your bags giving out if not carefully watched. Don't run these risks; a small leakage of gas, mixed with a certain amount of air in pipe, is liable to become ignited by a spark from a laborer's pick or pipe, or probably the lead furnace being too near to the end of your line, which compound, if ignited, might cause an explosion and probably cause serious damage. The safest way to lay mains is to leave your connection with the live

line until the last. Test the amount of pipe laid each day, which should average, "with the force of men mentioned," as follows: 1,600 feet of 4 inch, 1,200 feet of 6 inch and 1,000 feet of 12 inch. The above amounts, in my estimation, constitute a good day's work. Test with air pressure of from 5 to 7 pounds, using a 16-inch cylinder pump. Take registration of pressure on a 10-pound spring gage. If the gage shows a leak, test each joint carefully with a brush and a fairly thick lather of soap suds. A few words would not be amiss in regard to the closing of live lines by bagging. Care should be exercised in doing this work. You can get good satisfaction on smaller lines, say from 4 to 6 inch, by using an ordinary beef bladder, as it is much easier handled through smaller openings, say 1 inch, than a rubber bag. In cutting out or drilling holes for bagging purposes, do not leave any sharp projections that would be liable to damage the bladders or bags. In bagging your larger mains, say from 16 to 30 inches, cut 3-inch holes, fill up the threads with a little clay, which will add to the smoothness of the holes. If pressure on these mains exceed 30-10, use two bags. After you have inserted the bag into the main, for protection pass the handle of a pick on the opposite side of the bag from whence the pressure on the bag is exerted. Fasten the neck of bag to pick handle, allowing the handle to reach the bottom of the pipe. Then pump up the bag and cover well up with clay the neck of the bag and handle of the pick. Keep the clay moist and watch carefully. If you are encountering back pressure, use another bag placed about four feet from the one already installed. When you are carrying an excessive pressure, say 50-10 or more, it is advisable to use two bags so that you will be doubly protected in case anything should happen to either one.

The laying and distributing of mains requires careful consideration to the end that you must arrange for centralization of your main lines, thereby insuring thorough distribution. In taking off your laterels I do not recommend less than a 4-inch main. Arrange if possible to connect all ends of your lines, thereby giving complete circulation and equalization of the pressure, leaving no dead ends, or uncirculated points. If the pressure at the starting point should be 35-10, when the heaviest consumption is on, you should calculate to carry same conditions with small allowance for friction to the farthest end of your distributing line, when the territory is being taxed by consumption. My maxim is to keep up the pressure and lay mains of such size that they will be

adequate for many years to come. If your mains are laid as they should be, your leakage will not amount to any more than if you were laying smaller lines. By adhering to the laying of large lines, you increase your output and satisfy your consumer as well as yourself. It will then not be necessary to ask the question:

"What is the best way to reinforce insufficient pressure in certain sections of the city?"

Before commencing to lay mains arrange to test thoroughly by means of a hammer each length of pipe and fitting before it is allowed to be put in the trench. Before testing pipe or fittings place them on wooden blocking to give them resiliency and sound. Rap smartly its entire length; if a bell like sound is emitted, it is perfect. If a dull, leaden sound, examine carefully and remove defective part. These defects, such as cracks, are generally found at spigot end, by reason of this being the weakest part of the pipe. Examine carefully around the hubs of both pipe and fittings for blow holes or porous places. Before the pipe is ready to be lowered into trench pass a wire brush through its entire length to thoroughly remove any obstacle that might be within. Arrange for measurement of service connections, so the holes in main can be cut before pipe is laid. Hand the main to the pipe layers. Yarn well, level, block, and then level again. Then start your first calker cutting off the surplus lead, giving the joint its first calking. Then move him to the next joint, bringing up your second calker; keep forging ahead, allowing your third and most reliable man to finish and complete the joint. Start some of your laborers who have finished their sections, cutting out calking holes, excavating as far as the curb or opening up crossings for service connections to curb line. Put in all house or lamp-post connections while main line trench is still open. In grading your main use a 10-foot level with an adjustable scale from 1-10 to 10-10; never drop grade less than 3-10, which would in rule measurement be about 4 inches in 100 feet. While the line is being graded, plat your levels and distances between ascending and descending grades. Endeavor, when possible, to descend your grades back to main lines, or to a centralizing point, thereby saving your siphon-pumping stations. In placing your drip boxes, aim to draw from as much territory as you can, as it saves time and proves more reliable. After placing your drip box in main line, cut and tap a 1-inch hole in its top, to receive a ¾-inch socket, with thread cut on the outside. Then cut a piece of ¾-inch pipe 1 inch shorter

than the depth of your box, screw on ¾ socket, and paint outside of socket with a little red lead and litharge, which will harden quickly and make a very stubborn joint to uncrew. Screw socket in 1-inch hole tapped in top of box as tight as possible. Extend from socket a piece of ¾ pipe to within 4 inches of street level. Pass over this pipe a pipe of 1¼ inch "no threads" within 1½ inch or 2 inches from top of ¾-inch stem. Fill up between the 1¼ inch and ¾ pipe with heated tar. This will protect the ¾-inch siphon stem and add to its life and stability. Then nipple out the stem with a ¾-lengthening piece (which is a socket and nipple cast together). When this becomes stripped from the constant screwing on the siphon pump, it can readily be removed and replaced without digging up the street. This brings the siphon-stem within 1 inch of the street level when cap is screwed on. Cover this stem with a cast-iron top to protect it.

To facilitate the handling of lead, have lead pot and furnace on wheels, so you can easily follow your pipe layers as work progresses.

I do not approve of coating cast-iron pipe, for the reason that it interferes in making a perfectly tight joint. If necessary to cover pipe with a preparation to protect it from electrolysis, all well and good, but do not paint the inside of the hubs or within 6 inches of spigot ends.

In preparing joints use twisted tarred yarn, well calked and evenly distributed to the depth of about 1 inch. Be careful that before yarning the pipe is forced well up against the shoulder of the hub, making it impossible to allow the lead when poured to run through and form an obstruction, besides honeycombing your joint. Use for clays a 1-inch square piece of canvas-back rubber packing, cut in length to suit from a 3-inch to a 30-inch main. This packing is covered on the outside with a piece of thin flexible steel 1 inch wide and about 1-16 inch thick. Drill and rivet on to the packing, then rivet a lug on each end. In making your clays cut your packing 2 inches shorter than the diameter of the pipe. Place the clay around the pipe and draw it together by using an adjustable clamp. Take a small piece of clay and form the mouth to guide the lead when pouring joint. After removing clay you will find a perfectly smooth joint. A clay, if handled properly, will allow you to make about 500 joints before it becomes burnt or rotten. Said clay can be used in any kind of weather, wet or dry. If raining, pour a little lard oil in mouth of clay when the clay

is on the pipe. This will prevent the lead from blowing out, as it does with the common puddled clay. In making a joint allow from 2½ to 3 inches of lead, as it will insure a good joint if properly calked.

In ordering fittings, such fittings as tees and crosses, don't reduce them, but use the full size. In reducing use a reducer, as it allows you every chance to draw from your main line, providing your laterals are extending with a descending grade; not only that, but it gives you an opportunity to enlarge without cutting out your main-line fitting. After you have completed your main line for the day, close up the end of your line by means of a wooden plug, well clayed. Drive a bar in front to prevent its falling out. This will keep the water out of your lines over night. Have a good, reliable man for a night watchman, whose duty it is to take care of red lanters, prevent accidents, and look after the company's material.

Service Pipes.—The process of preparing service pipe preparatory to its being installed, is as follows: This process adds considerable life to the pipe. The surface is considerably heated and then dipped in a specially prepared bath of tar, containing turpentine and pure rubber. Place a barrel of tar paint in a cauldron over a coke fire. When boiled, add1 gallon of turpentine and 1 pound of pure rubber. Stir until the rubber is thoroughly dissolved. Then draw it off into a square iron trough 24 feet long, 15 inches wide and 18 inches deep. On the bottom is arranged a steam coil; outside, and directly over it, are the drainage racks. At the end of the trough is a specially arranged rack, with adjustible rests for supporting the pipe. At the end of the rack there are 18 steam jets placed in such a way as to enter each length of pipe as it lies on the rack. When ready to begin tarring, turn steam on tar tank, which takes about one hour for tar to boil. While waiting, arrange pipe on steaming rack and as soon as tar is heated, turn steam into pipe on rack, which requires about three minutes to become heated. Cap and plug each length. Pick up length by special hooks and drop into tar tank. Allow it to remain in bath about five minutes. While waiting, place another batch of pipe on rack. Turn on your steam while waiting, and then remove pipe out of tank and place on dripping rack. Remove your caps and plugs, and keep up this process until you have tarred enough pipe to last a season. In figuring up at the end, you will find that you have tarred on an average of 350 pieces a day. Keep tar tank well filled, and at boiling point at all times.

After written application has been made for service, a service plat is made out, giving name, location, size of service to be installed, showing upon the plat which side of street the main is on, and also size. The foreman of service men receives plat, and takes his men with him on street car, if necessary. Before going, he notifies his driver to stop at nearest storage station, of which we have five distributed throughout different parts of the city and suburbs, to get necessary pipe for the completion of work laid out. Said system saving time, as well as wear and tear of horses and wagons. The foreman, upon his arrival at premises, makes careful examination of the premises, locates the main line of building, endeavoring to install service as close to the line as conditions will allow: avoiding cellar openings, sewer and water trenches, trees and plants, etc. After deciding on best location, he then opens up the street directly over the main. Lines out his service trench, and then starts his men. After main is uncovered, he buckles on his drilling machine. This machine performs its functions thoroughly, drills and taps a good clean hole, and allows no gas to escape, thereby protecting your men.

We install nothing less than 1¼-inch pipe, well tarred, and laid with a good grade to the main. Thoroughly block and connect main by side holes. I do not advocate top holes for the following reasons: Too easy to become obstructed, too liable to sag and trap; cannot be cleaned out thoroughly, and do not admit of being well blocked. The only occasion for a top hole would be when the main is very deep, occasioned by the regrading of a street.

To Reinforce Pressure.—In reply to the second question asked, regarding the best way to reinforce pressure in a certain district in a city, it is problematical. As the conditions existing could be effected by numerous agencies, it is puzzling to one to get a basis upon which to form or come to any definite conclusion in giving specific information.

In the fall of the year I would start out a half dozen good, reliable men to take pressure between the hours of 6 and 7 P. M. (the hours of heaviest consumption), at points along the line of affected districts; as also to take pressure at points along line of general main, outside of district in closest proximity to district affected.

Then compare the pressure with those at the works. This will show the deficiency and location of the trouble, which might be improved by the following suggestions:

See that your mains are clear, and of sufficient carrying capacity to give you volume and pressure when the consumption is heaviest, allowing a trifle for friction.

The conditions regarding pressure would be the same on a 1-inch line, as it would be on a 24-inch feeder, providing there was no consumption taken off the lines. But if you find that your pressure has greatly diminished by reason of heavy drag or consumption taken from it, it is due to obstruction or insufficient carrying capacity, and location of your main feeders.

This will apply as well to your laterals.

In order to supply a district it is necessary to keep up your pressure at the works when the supply is in demand. Delivering it to the different districts with large feeders, taking as few tributaries as possible off the line before reaching the outlying districts. If the existing conditions are such that the capacity of the main feeders of the affected district is of such size as to be inadequate for the demand, extend a separate and distinct feeder, allowing no tributaries to be taken off until it reaches the district to be reinforced. This should be extended direct from the largest carrying main which shows the smallest diminution of pressure, when the greatest consumption is on. If this cannot be accomplished, then extend it direct from the works.

If you have not sufficient facilities to obtain more pressure, increase the capacity of the works.

N. B.—It would be well to figure up the probable consumption during the month, of the entire district, then figure out and compare with tabulated volume statistics of the capacity of mains now supplying the district.

In conclusion I wish to express my thanks for your patience and kind attention, but if the few disconnected thoughts afford a basis for discussion the object of this paper will have been accomplished.

BEST WAY TO EXTEND GAS MAINS.

B. W. PERKINS.

The plan outlined by Mr. Franklin as being the best way to introduce and extend mains and services into suburban villages and new territory is about the way I think most people would do it; at least it is about the way we did it at South Bend last spring when we laid a main to Mishawaka, a distance of four miles. We

had the choice of two routes, one on the south side of the river, and the other on the north side. In making a choice we considered the future rather than the present, as giving the greatest possibilities for consumption between the places. Our choice was on the side that had the fewest houses, because it offered the greatest inducements for the future. It had more desirable ground that was not encumbered by steam roads, more energy was being put into the sale of ground by the owners; it had good street car facilities, and numerous other advantages the other route did not have.

After selecting the route we made a canvas of the territory, with a view of getting as many pledges as possible, but found that people in most cases were "doubting Thomases," not caring to sign any contract until the main was laid on their street. We did not let this deter us, however, as we had made up our minds to deliver the gas there, and not "let up" on them until they used it, and our subsequent success and prospects for this summer show that pledges are not necessary in territory into which it is desired to enter.

I might add that Mishawaka is lighted by a municipal electric light plant, which may account for the lack of pledges. I fully agree with Mr. Franklin that all this may appear comparatively easy, but it takes time and perseverance to get the right kind of a franchise, etc., particularly if you have to secure three, as we did.

I think about the first thing to be considered would be whether a high or low-pressure system would be used. In the case at South Bend we used the low-pressure system, because we think in time the territory between the two places will be built up solid, and it would not differ from any common extension in town. Mr. Franklin's system for doing the work is the same as we use, with the following exceptions: We have pipe delivered on same side of street that it will be laid, so that after the trench is marked out the pipe can be rolled up to the edge and dirt thrown on both sides, which makes a barricade. The width and depth would have to be regulated by the character of the ground and the climate. We find tamping earth under a main in the same manner as railroad ties are tamped into position is better than blocking and flushing, as by tamping every inch of pipe has a bearing.

Two gas bags instead of one, in pipes 10 inches and larger, are good both for the protection of your men and avoiding the

risk of extinguishing the gas in a neighborhood by the rupture of a single bag. We have not found the hammer test for cracks to be infallible, so prefer to have each piece examined by a workman, in addition to testing by hammer, and when by the latter would prefer to do it while it is suspended by the derrick, as you have only one bearing and that by a rope.

In leveling we have found an architect's level mounted on a tripod a valuable addition to the one in the ditch, particularly at the street intersections, or when a section has to be left out for any purpose. We have found drip boxes placed inside of curb line preferable to ones placed in street, as they can be dug up for repairs without cutting into pavement, and the pump pipe can be left above the ground. If the clay used to form the gate in the rubber jointer is tempered with lubicrating oil instead of water it will not harden by the heat of the lead, and will save time and blowing.

We have found that stucco makes an excellent temporary joint for putting in temporary plugs, connecting new mains with old over night, etc. We put fittings full size, but put a piece of pipe into the branches before the reducer, so that when the time comes to remove it a bag can be put into the piece of pipe instead of the main line. You thus avoid cutting off the main line.

DISCUSSION.

MR. WHYSALL:—Are we to understand from Mr. Perkins' paper that he would swing the street main into the sidewalk in order to get the drip box under the sidewalk?

MR. PERKINS:—No; I put the drip box at the curb and connect it with a small pipe.

MR. STONE:—I do not understand from Mr. Franklin's way of making a service-pipe connection to the main whether he uses what is commonly called a swing or tap into the street.

MR. FRANKLIN:—We run it in perfectly straight. That always gives you a chance to clean it out when so desired.

MR. STONE:—We level up our trenches somewhat as they level up sewer trenches. We run levels with the engineer's level and grade the bottom of the ditch to the desired line, and then lay the pipe on the bottom of the ditch. A man can level up 1,200 or 1,500 feet of ditch in an hour or two and have the stakes all driven in the morning, and doesn't have to bother with leveling

the remainder of the day. As the bottom of the ditch is dug according to the line laid out, we do not have to plug or tamp under a pipe, and it has a perfect bearing all the way through. I would like to bring up another thing. I have no opinion on it myself, but I would like to know the relative efficiency, cost of availability of cast-iron and wrought-iron pipe at the present time for street-main work. I notice that both of these gentlemen who have just read papers speak of laying cast-iron pipe. Wrought-iron pipe, I know, costs a little more at the present time, but it can be laid faster, and I have wondered, taking everything into account, whether it would not be better than cast-iron pipe and not as liable to break.

MR. FRANKLIN:—In regard to that, I would suggest that the difficulty in laying wrought-iron pipe is that it is not of sufficient thickness to insure good connections for services. Then, it has not the lasting qualities. The conditions are not always the same, owing, I presume, to the different character of the soils in which it is laid. I think you will find the life of wrought-iron pipe in soils, for example, where I have seen it tried, to be not over 10 years. But the life of cast-iron pipe is practically without limit. Another thing is that you have the thickness with cast-iron pipe that you do not get with wrought-iron pipe, which is a very important feature to be considered in regard to tapping.

JOHN R. LYNN:—In regard to tapping wrought-iron pipe, by the use of a swedge, you can get thickness enough for your thread, so I do not think that is a source of objection at all. You can get thickness enough that way very easily.

MR. FRANKLIN:—I do not know where you can find a piece of wrought-iron pipe thicker than ¼-inch, and, for instance, on a 2-inch service, that doesn't allow you more than 3 or 4 threads, and that is not sufficient to withstand the strain of a 2-inch service. If you swedge the hole out you weaken the pipe.

MR. LYNN:—You might use a saddle.

MR. WHYSALL:—My experience is that you can get a very satisfactory joint by tapping wrought-iron pipe, and it will give you sufficient strength to pull the service pipe apart without the threads pulling out of the mains.

J. D. S. NEELEY:—My experience has been in favor of wrought-iron pipe, more particularly in natural gas mains than artificial mains, in regard to its lasting qualities. I have a line

in mind now that has been in use for 16 years, and we have carried 200 pounds pressure on the line when we have had it, which was a good deal of the time. While we have had to cut out two joints in the last five or six years,eaten up, I presume, by some alkaline substance in the ground, the rest of the pipe is practically as good as new. My experience with cast-iron pipe in several artificial plants that I have had to do with, is that it does not practically last through a life time, as suggested by Mr. Franklin, but that it does rust and eat out. I have taken up some pipe in one or two towns in Ohio and one or two towns in Indiana—cast-iron pipe that has been down in the ground not to exceed 17 to 20 years—and it would not bear its own weight. I do not know what was the trouble with it, but it was so rusted out and eaten up that you could take a knife and shave it off. I believe that wrought-iron pipe will last as long in the ground as cast-iron pipe and you can make just as good a tap in it as with cast-iron, and just as tight a joint, especially if you tap in the top of the pipe. If your pipe is not too large, say a 4-inch main, it is a very easy matter to have a top tap and use a swing that will give you a good connection.

Mr. McMillan:—I have taken up over a mile of pipe that had been down between 15 and 16 years and there was probably in that whole amount about three lengths that I could not with my hand dust off and find the original marks on the pipe showing the number of feet in it. It was wrought-iron pipe and was in splendid condition even after service for the number of years indicated.

Mr. Dunbar:—Mr. President, Mr. Franklin speaks of a cylinder pump in order to obtain a pressure of 5 to 7 pounds on the main. I wish he would please tell us if that differs from the ordinary cylinder pump, and where he obtains it and his method of using it to keep the end of his pipe tight while he is testing it. He also speaks of a specially prepared tarred yarn, and I want to inquire what kind of tarred yarn he uses?

Mr. Franklin:—In regard to the pump, it was a small double-handled cylinder pump, 16 inches in diameter—an ordinary suction pump. In testing a line of 1,800 to 2,000 feet, we generally put in an iron plug and calk it at the end of the line. In testing we pump up to about 7 pounds and then test every joint before anything further is done with the line or before any dirt

is put in. With reference to the kind of tar used in the preparation of the tarred yarn, I will say that it is simply ordinary tar, so that it makes a good solid packing when calked into the joint. The yarn is the jute commonly used.

MR. LYNN:—I may state that I have taken up quite a good deal of wrought iron within the last few months that was in almost as perfect condition as it was the day it was put in. It ran through several different sorts of soils and had been in the ground about 18 years. I would state further that I have taken up cast-iron pipe that had not been in very much longer than the wrought, and it was in much worse condition.

MR. FRANKLIN:—With reference to wrought-iron pipe I will give you our experience in the Cincinnati Gas Company. We have taken up mains that have been in the ground for 40 years, a pretty long time, to enlarge them. They were cast-iron pipe, and were in just as good condition as the day when put down. I have taken out three-quarter-inch services in the past three years, a little over 1,100 of them, and I have removed within the last year over 2,000 lamp services of wrought-iron pipe. The conditions, of course, in Cincinnati may differ entirely from other places. In a gravelly, sandy soil, wrought-iron pipe will last 15 or 20 years, but with conditions as they are in and about Cincinnati, where the ground is hilly, and where it has been filed up by ashes and debris and other products, wrought-iron pipe will not last longer than three to five years. I had occasion to put in a two-inch service one year ago, and I found the old two-inch service rotted out. So far as the lasting qualities of wrought-iron and cast iron are concerned I think there is a vast difference. You will find that the cast-iron will outwear the wrought-iron mains three times over.

MR. LYNN:—There is not much comparison between the thickness of a three-quarter-inch wrought-iron pipe and a four, six or eight-inch cast-iron pipe. I do not think Mr. Franklin, in removing any of that cast-iron pipe, which he found in such excellent condition, ran across any that had been buried in cinders. I had occasion to renew a cast-iron connection which ran through a cinder bed, and by the time we got the pipe out of the ground it actually had fallen to pieces.

MR. LITTLEHALES:—Mr. President, my experience indorses that of the gentleman from Cincinnati very fully. I have found services that have been laid uncoated, entirely and absolutely

destroyed in three years in some soils, whereas, perhaps a few feet away the pipe would be as sound as the day it was laid. The two weakest spots I have always found in services are located right under the gutter and under the eaves, where the water is constantly soaking and the pipe gets alternately wet and dry. Under the gutter, and under the eaves of a building is almost invariably the worst point. I take it for granted that no one lays service pipes now without coating them in some way or other, and that, of course, adds very materially to the life. I had occasion to take out, two or three years ago, a great many hundreds of old services, and I found them, well, they were curiosities worth keeping, for the extraordinary way in which they had been eaten through; and yet, in some of those same pipes, a few feet from the worst places, they were just as good as the day they were laid, so that it would seem to me that the difference in the soil had a great deal to do with it, and that wrought-iron pipe was much more affected by the difference in the soil than cast-iron pipe, and that, while you may find it in one place in perfect condition after many years, yet, two or three feet away from that, you may find that it has been completely destroyed.

Mr. Stone:—I went into the matter this spring, of wrought and cast-iron pipe, because I expected to lay between 10 and 20 miles of main this coming summer, and I was in doubt as to the best kind of pipe to lay. I found just about as much difference of opinion as has been expressed here to-day. I wrote to 14 or 15 different people, and found that about half of them recommended wrought iron, and the other half recommended cast iron. I was somewhat surprised at the result. I went to Pittsburgh to see Mr. Young. I saw both Robert Young and John Young about the matter, and I was very much surprised to find that they had changed, and were now strong advocates, both of them, of wrought-iron pipe at the present time. One of them put forth a ground that has not been suggested here as a reason for the use of wrought-iron pipe. He stated that during the month previous he had had 27 breaks in his main line of cast-iron pipe, where he had not had one in his wrought-iron pipe. And he stated the trouble and bother of keeping up the cast-iron pipe, owing to the breakages, was a great deal more than that of the wrought-iron pipe.

Mr. Lynn:—I think any of us will find the percentage of leakage in a good cast-iron system will be materially greater than

the percentage of leakage in a good wrought-iron system. I think that has been the general experience of those who have experimented with both.

MR. FRAKNLIN:—I would like to say one word in regard to that, Mr. President. We have something like 415 miles of cast-iron pipe throughout the city of Cincinnati and suburbs, and our percentage of leakage last year was a little over 9½ per cent., and I think that is speaking pretty well.

PRESIDENT DOHERTY:—I would like the floor just long enough to say that percentage of leakage does not amount to anything. It all depends upon what you sell. If you do not sell any gas you have 100 per cent. leakage.

MR. FRANKLIN:—I had occasion a few days ago to take up a service at the corner of Fifth and Main Streets, in the city of Cincinnati, which traced by the records, I think, was the fourth service put down in the city of Cincinnati when the Cincinnati Gas Company was first inaugurated. That was 42 years ago. It was a three-quarter-inch cast-iron pipe.

PRESIDENT DOHERTY:—Gentlemen, are you all satisfied that wrought iron is the best and are you all satisfied that cast iron is the best? This is a pretty important subject.

MR. STONE:—I really think, if we lay wrought-iron pipe, it ought to be coated just as has been described by Mr. Franklin. I think the main pipe ought to be coated as well as the service. The cost of coating does not amount to a great deal, and it more than pays in the long run.

MR. MULHOLLAND:—I would like to ask whether any members have had any experience as to which, if either, wrought-iron or cast-iron pipes best withstand electrolysis or electrolytic action.

MR. FRANKLIN:—I may say in regard to that that I think there is very little difference between either one of them. One is about as liable to be affected as the other. We are not troubled with it in Cincinnati because our systems there are double trolley systems. However, in the suburbs we do encounter some difficulty of that kind. I remember one instance where there was a single trolley system, we had a cast-iron pipe eaten out and the services were eaten out.

MR. MULHOLLAND:—My question was, which, if either, best withstands the electrolytic action? Suppose there were two parallel lines, both subjected to the same amount of current or voltage, which kind of pipe will best withstand the electrolytic action?

MR. FRANKLIN:—I still stick to the cast-iron pipe.

MR. LYNN:—If there is any advantage in that regard, in the cast-iron pipe, I think it must be due to the extra thickness of the pipe, for I cannot see any other reason.

MR. WHYSALL:—I understand the proposition to be that we have two parallel lines supposed to carry gas, but part of the time at least are carrying electricity. The cast-iron pipe having the greater cross-section, will probably carry a greater amount of current, but the lead joints are an obstruction, and when the current passes from the hub to the spigot and jumps through the lead there is quite a resistance, and the result is that the lead tears out, and in several instances, an analysis of the soil removed from around the joint indicated the presence of considerable lead and that would be also substantiated by the fact that the lead in the joints was loose.

MR. LYNN:—Mr. President, I think water companies are having about as much trouble with their lead services as we are with our mains from the electrolytic action.

QUESTION BOX.

PRESIDENT DOHERTY:—We have one query here in the question box that is very pertinent to this subject and that is

Question 7. What is the best coating for services and main pipes?

I think that question may very properly come up for discussion at this time. A great deal of what has been said about electrolytic action depends upon, I think, the specific conditions of particular cases. There are so many conditions which affect the results of electrolysis that unless you know the specific conditions it is very hard to draw any conclusions which are at all valuable from any reported observations.

MR. LITTLEHALES:—I would like to say so far as my experience is concerned that the best is impracticable on account of its cost. I believe the best is red lead. I have tried that very extensively, and I find it a long way ahead of anything I have ever tried. Following that, I presume, would be the bituminous coverings. The bituminous covering, I suppose, is the best practicable coating. You should try to get the tough quality rather than the brittle, just keeping it below the brittle character. I believe, however, the best of all coverings to-day is red lead, from my personal experience.

MR. FRANKLIN:—I have a reference here in my book stating that asafœtida is quite a preventive of electrolysis. I never have used it or had occasion to use it, but I have a memorandum here of it in my manual. I suppose that refers to asafœtida paint.

PRESIDENT DOHERTY:—I think Mr. Littlehales' suggestion about red lead has one disadvantage. Its conductivity is greater than tar or paraffine or anything of that sort and there would be a greater protection from electrolysis by the use of a compound of high insulating quality.

MR. STONE:—Would not good coal-tar make good coating for service pipes and pipes of that character, if applied hot, and have a thorough coating given to the pipes; would it not make a good coating?

MR. FRANKLIN:—That is just what this preparation is. It is a preparation of coal-tar, turpentine and rubber. The object of the rubber is to make it elastic and stick to the pipe or to make it adhesive.

PRESIDENT DOHERTY:—Rubber has a very high resisting quality. The object of it, I presume, is to make the coating elastic.

MR. MCILHENNY:—I think general experience has taught as well as individual experiment, that coal-tar, if used upon iron of any kind should be heated, not necessarily to the boiling point, but should be heated in order to expel the small quantity of ammonia which it always carries, and also lime should be used or some other alkali to neutralize the acid present. There is a certain percentage of carbolic acid in crude tar; if sprinkled well with powdered lime it makes the tar a little bit thicker as well as neutralizing at the same time the acidity. I have known of iron coated with crude tar to rust out very rapidly, but where the tar had been treated with lime that acidity had been corrected and it was all right.

"TURNING NATURAL GAS INTO MANUFACTURED GAS MAINS."

PRESIDENT DOHERTY:—I have been requested to ask Mr. Stone a question. I would like to inquire of him what the effect was when he turned natural gas into his artificial gas mains at Ashtabula, Ohio.

MR. STONE:—I did not notice any difference so far as the mains, the services or the meters were concerned; if I did not wish any consumer to use any larger quantity, I do not believe I would have needed to make any change at all. But as far as the consumers were concerned there was quite a difference. The higher

pressure given caused it to pass through at a greater velocity. This resulted in a large gas-stove consumption, and as we had a number of open tips and a large number of Welsbach lights—all the gas stoves smoked—in the Welsbach lights the blaze went up through the chimneys and broke them, and the open flames scarcely gave any light at all; the consequence was that when we made the change it became necessary for us to start several gangs of men over the town, each one taking a different route and adjusting things as they went along. We were four or six days doing nothing else but adjusting gas stoves and Welsbach lights and trying to instruct the people as nearly as we could in regard to the uses of the new fuel. Outside of the trouble with our consumers I did not experience any other.

Mr. Andrews:—I would like to ask Mr. Stone what pressure he carried on the lines after he made the change?

Mr. Stone:—Of course we knew we were going to turn the natural gas into our mains. So in order to get the people as nearly ready as we could we increased our main pressure to 30 tenths on the old coal-gas. We carry 6 ounces on our lines in town at the present time, which would be equivalent to a little better than ten inches.

James W. Dunbar:—Mr. President, is not the specific gravity of natural gas much greater than the specific gravity of artificial gas? About 95 per cent. of natural gas is marsh gas, CH_4. The combined molecular weight of marsh gas is 16. About 45 per cent. of coal-gas is hydrogen. Now about 40 per cent. of coal-gas is marsh gas, so it would seem to me that natural gas would have a specific gravity greater than artificial gas.

Mr. Eysenbach:—As a matter of fact, the specific gravity of natural gas is greater than that of coal-gas. Of natural gas it is between 5 and 6 tenths; of goal-gas it is between 4 and 5 tenths.

President Doherty:—I think water-gas will go over six, and natural gas, I think, would go about five and one-half. What do you say is the specific gravity of water, coal and natural gas, Mr. Shattuck?

J. D. Shattuck:—Water-gas, 0.650; natural gas, 0.502; coal-gas, 0.420.

Mr. Dunbar:—I made a calculation the other day of specific gravity of coal-gas, and I was surprised to see that it did not go to 0.4, if my calculations were correct. I found they were below

0.39. I took the gas as Mr. McMillan analyzed it, and in calculating the flow of gas through pipes in the formula the specific gravity I had used was 0.42, and in a place where it was illustrated by calculation a specific gravity of 0.39 was given. Then I calculated it and found that 0.39 was about correct.

MR. EYSENBACH :—I have seen it given all the way from 0.36 to 0.42 for coal-gas.

PRESIDENT DOHERTY :—By analysis it will come close to 0.42 I think, if Mr. Dunbar will not calculate it, but will measure or weigh it he will find it will go very close to 0.405. I do not state that as a positive fact, as I have not done any work of that kind for a long time.

MR. LYNN :—I may state that it may vary with the amount of air that is in it.

PRESIDENT DOHERTY :—It will vary with the amount of water-vapor too, I think.

MR. LYNN :—I do not think water-vapor is generally specified in the analysis.

MR. WHYSALL :—I had occasion to test the specific gravity of our gas some time ago, and I found that for 18 candle-power coal-gas, the highest and heaviest was 0.509, and the lightest 0.485. The natural gas in this district runs about 0.65. When you adjust a Welsbach lamp to 2 inches pressure, with artificial gas, and then attempt to run the same lamp and get the same degree of light with natural gas you have to cut your pressure down to about 1.5 inches.

PRESIDENT DOHERTY :—I would suggest that we ask Messrs. Shattuck, Whysall, Eysenbach and Dunbar to report to-morrow on the specific gravity of coal-gas, water-gas and natural gas. I will appoint them as a committee to make a report on that subject to-morrow.

MR. LITTLEHALES :—I have made a great many examinations by the effusion test, and I have found coal-gas when there was no CO_2 present to run from 0.42 to 0.43. I have made as many as a score of those tests by the effusion method.

GEORGE W. BARNES :—I think we are drifting away from the information that the gentleman was seeking. I think his trouble was due rather to the insufficiency of air, owing to the fact that artificial gas of the same volume requires much less air than natural gas to create the same efficiency of combustion. I do not think the relative specific gravities would change the flow materi-

ally, but the openings of air in his mixers would cause smoking and trouble rather than the increased quantity of gas.

President Doherty:—Gentlemen, if there are no more comments on this subject, we will go to the next paper, being a discussion on the "Equity, Legality and Advisability of Charging Different Rates for Illuminating and Fuel Gas," by Emerson McMillin, Paul Doty and Henry L. Doherty.

Emerson McMillin's discussion on this subject was then read as follows:

ADVISABILITY OF CHARGING DIFFERENT RATES FOR ILLUMINATING AND FUEL GAS.

EMERSON M'MILLIN.*

Clippings from the newspapers published in Detroit have been sent to me, in which it is stated that you deem it your official duty to see to it that the Detroit City Gas Company does not charge two prices for its gas. I write to you now on the assumption that these statements are substantially true.

Whether the provisions of our city franchise providing for two prices are legal or otherwise, they are at any rate what the city demanded, and whether legal or not can only be determined by the courts. I desire, however, to call your attention to a few facts bearing on the question, that to me seem to warrant the two prices.

First, it has been the practice for most of the cities of this country for many years to make a different price for gas used for fuel from that charged for gas used for lighting. It being customary to do this, of course, does not make it right, but it is reasonable to assume that if it is demanded by the public and conceded by the gas companies it must be mutually beneficial.

During the first half century of gas lighting, prices for gas were, compared to present prices, very high, and yet the business was not more remunerative than other classes of business in which men were generally engaged. The limited sales required that the gas be sold at a high price, in order to pay an interest on the investment in plant. It was obvious that the only feasible way of reducing the price, without loss, was to increase consumption. But increased consumption meant increased investment, unless some means were found for increasing capacity of existing plants. This desideratum has been secured through the encouragement of the use of gas for fuel, chiefly for cooking.

*Letter addressed to the mayor of Detroit.

Only a few years ago, nine-tenths of all gas consumed was sent out during the first three hours of the night, but little during other hours of the night, and practically none during daylight. With a plant, holders, mains, meters and services of a capacity of supplying 1,000,000 feet per day, under old conditions, there can now be distributed 2,000,000 feet per day. Again, the plant of a gas company must have a capacity in excess of the maximum winter demand. This demand used to be four times the quantity demanded in summer. But fuel gas is used chiefly in summer, and this new business is gained with but small additional investment. This change in capacity has been the principal factor in enabling gas companies to reduce the figures at which they can afford to sell gas.

In this respect the gas business does not differ materially from other mercantile undertakings. If a dry goods or grocer merchant were compelled to keep open 24 hours each day, and sell goods but three or four hours, the cost incident to the conduct of his business would be greatly increased. Gas companies are now enabled to use their plants practically all the time, the noon hour often being the hour of largest consumption.

Apparently parties agitating this question are under the impression that the two prices inure chiefly to the benefit of those who are most able to pay. The reverse of this is true. Well-to-do families will pay from two to five times as much for their lighting gas as their fuel gas, while thousands of small consumers will pay more for fuel than for lighting. In fact, in nearly all the cities where the writer is interested in gas, the companies go to the expense of piping the poor man's cottage, where fuel gas is used, in order that the occupant may have gaslight as well as gas for fuel—the company being compensated, in a measure, at least, by thus increasing the revenue to be derived from the investment made in laying the main and the service pipe to the man's residence. Hundreds and possibly thousands of laboring men in your city have asked for fuel gas, who did not feel able to pipe their houses for the use of illuminating gas; many, in fact, use gas for cooking who do not feel able to light with gas, even if their houses are piped for that mode of illumination.

It is not the desire of the gas company to discriminate, but if the adoption of such systems as years of observation and experience have determined to be advisable should make apparent discrimination, we, I trust, are all agreed that it should be, as in the

present instance, in favor of those least able to pay. The fact is, however, that the same prices are given to every consumer—$1 for lighting, 80 cents for fuel and 60 cents for gas engines. The franchise ordinance does not require us to sell gas for power at 60 cents, and consulting our own direct interests, we should decline to make the concession; but men have made investments in gas-engine power, expecting to use natural gas. This they can no longer obtain. We have felt it our duty to assist them all we can to utilize their plants. Some others who could never get natural gas claimed we ought to help them by giving them cheap gas, in view of the fact that we could not afford to lay natural-gas mains to their premises. We try all we can to meet the views of our patrons. Indirectly, whatever assists the manufacturing interests of Detroit assists the gas company, and we have acceded to their requests. Does this do injustice to the general public? We think not. We do not charge more to others by reason of this concession; while on the other hand, gas engines, being larger users of gas, materially increase our output, and hasten the time when, under the terms of our ordinance, we will have to reduce the price to all consumers.

To read publications now being made, one would infer that we had been surreptitiously charging two prices; while the ordinance of this city, during the past eight years, has required this, and nearly half a million bills sent out annually from the gas office have carried on their faces the evidence of such fact. I believe no one can truthfully charge the gas company with a failure to faithfully carry out all the conditions imposed by the city franchise. It deserves no special credit for this. It entered into those conditions with its eyes open and after long discussion. It has in the last three or four years expended $1,500,000 in improving and extending its plant, putting in nearly double the amount of money it has taken out through the payment of interest on bonds, and a few dividends on the stock. It now pays about double the amount of taxes it paid before the present franchise was granted. It has done all in its power to satisfy its customers and the public authorities. Coal and oil, out of which it must make gas, have nearly doubled in cost, yet it has not asked a rise in price.

Quasi-public corporations should be held to rigid observance of their contracts and obligations with the public. Is it possible that the obligation to live up to a contract should apply only to one party?

CHARGING DIFFERENT RATES FOR GAS.

PAUL DOTY.*

I thank you for your letter and kind invitation, and as requested, I have sent to St. Paul my reply by wire. The telegram reads: "Regret am obliged to decline invitation to discuss subject suggested." I am obliged to do this for the reason that affairs in Detroit are so strenuous I feel I cannot give the time the subject demands.

My own opinion is, as you know, that in the present state of the art, there should be no discrimination in price. If a discrimination be made, it should be regarded simply as a business expedient, and whether public service corporations can make business expedients or not, legally, I do not know. I do know, of course, that such discriminations have been made, and made very generally, but the fact that they have been made may, or may not, make them right in the eyes of the law. Custom largely governs our actions in life, and as "Use is the law of language," so custom may be the law of business.

Gas for fuel is no longer an infant industry, and needs no protection. Gas for lighting is a reviving industry, and I think needs the encouragement of, at least having for its price, the same rate as gas for fuel. There is this to be said, however, the fact that we have hitherto offered a lower rate for gas for fuel came from our ability to make this lower rate depending upon the fact that we received a higher rate for gas for light. You know we sell gas for power at 60 cents per 1,000 in Detroit. I regard this price as simply a business expedient. Our ability to sell gas at 60 cents for power is due to the fact that we get 80 cents for fuel and $1 for light. I told a reporter who asked me why we sold gas at 60 cents per 1,000, that we could afford to sell some of our gas all of the time for 60 cents, and all of our gas some of the time for 60 cents, but we could not sell all of our gas all of the time for 60 cents.

Strictly speaking, if a public-service corporation must give absolute regard to equity before the law, then all of the business expedients, such as discount for prompt payment, discount for quantity of consumption, discount for nature of service, or for any other cause, must give way.

*Letter to Henry L. Doherty.

The President called Vice President Andrews to the chair and then read to the Association his written discussion upon the same subject, as follows:

CHARGING DIFFERENT RATES FOR GAS.

HENRY L. DOHERTY.

There seems to be a growing tendency towards the belief that we should sell all of our gas at a uniform price per 1,000 cubic feet to all customers, and regardless of the quantity of consumption. The sale of gas at a uniform price per 1,000 cubic feet is unquestionably inequitable, and equitable charging can only result from charging on the same basis as our costs. Our expenses are influenced by:

A. The number of consumers or meters we have.
B. The location of these consumers.
C. Their maximum demand.
D. Their consumption.

Expense "A" is a fixed cost unaffected by the quantity of consumption, and should be charged regardless of consumption. It is made up of investment expenses, expenses of reading meters and maintaining meters and services, and cost of bill making and collecting.

Expenses "B" and "C" are similar to "A," but made up more largely of investment expenses.

To be equitable, a flat charge for "readiness to serve" should be made, based on these fixed expenses, and then gas should be charged at a uniform price per 1,000 cubic feet sold. A similar system to this is used by some electric companies, and the electrical fraternity have given this question of rates much consideration, and I predict that in 10 years every electric company will have ceased to charge for current at a uniform rate per kilowatt hour.

I have tried to find some way to equitably apply this system of charging to the gas business, but have not yet been successful. I cannot admit that any other system of charging would be equitable, but I believe differential rates for fuel and illuminating gas to be more equitable than a uniform rate.

I can pass no opinion of value on the legality of such discrimination, but I would have little fear of any of the higher courts

declaring such a differential rate illegal, if the case were properly presented. I firmly believe that such discrimination is advisable. To sum up the opinions as set forth above, I believe:

First.—That none of the systems of charging for gas that are now in use are equitable.

Second.—That a lower rate for fuel gas is more equitable than a uniform rate.

Third.—The differential rates between gas used for fuel and illuminating purposes would be sustained by the United Sfates Supreme Court, if properly presented.

Fourth—That such differential rates are advisable.

To support my first position, I will assume that you will all agree that our expenses depend on the uniformity of our send-out. That is to say, our cost would be a minimum per 1,000 cubic feet if our send-out were absolutely uniform for each hour of the year. I think you must all agrée on this broad ground, and having admitted this, you must then admit that the more nearly we approach this condition, the more nearly will we reach our minimum cost.

To support my second position, I must demonstrate that the use of fuel·gas tends to bring about the condition favorable to minimum cost prescribed in my first position. I think you must all agree that development of the fuel market to the present extent has given us a higher average load compared to our maximum load than was obtained when nearly all our gas was sold for lighting purposes. If necessary, I think I can demonstrate this point to your entire satisfaction. Expenses, in the sense I am using them, must include both operating and fixed expenses. If our gas at Madison, Wis., were all sold for illuminating purposes, it would so increase our maximum demand that our mains would have to be of a size to yield nearly three times their present conductivity. Our send-out there has been so uniform throughout the 24 hours of the day that we have been able to get along with a holder capacity of about 33 per cent. of our maximum day's output without serious inconvenience. Our difference in price between gas used for fuel and illuminating purposes is 25 per cent. per 1,000 cubic feet, and we think our expenses, including interest and depreciation on the additional equipment demanded, would equal this difference if we were selling all our gas for illuminating purposes. In addition to this, few of us could sell illuminating gas with the same degree of profit if our fixed charges were not

partially supported by our sales of gas for fuel purposes, and such sales of gas for fuel purposes would be considerably less if we attempted to sell at our maximum price or even at the price which we now average.

My third position is based on the view the courts take of discrimination in railroad rates. Every argument which can be made for the sale of gas at a uniform price per 1,000 cubic feet can also be made to support the contention that railroads should charge a uniform rate per ton mile, regardless of the length of haul or the class of freight. The Interstate Commerce Commission, a national board of control, not only countenances discrimination in railroad freight rates, but counsels it. How can the United States Supreme Court support discrimination by one quasi-public corporation and refuse it to another when both can be measured by the same reasoning?

My fourth position is based on competitive conditions, and for comparison we must reduce gas and all competitive commodities to a uniform measure of light and heat, namely, the candle-power hour and the British Thermal Unit.

I will therefore assume the following money and energy values:

Gas, $1 per 1,000 cubic feet.

Soft coal, $4 per ton.

Electric current, 10 cents per kilowatt hour.

Hard coal, $8 per ton.

Kerosene, 10 cents per gallon.

Gas burned in open tip, 3 candle-power hours per foot, horizontal measurement.

Gas burned in incandescent burner, 20 candle-power hours per cubic foot, horizontal measurement.

Kerosene burned in good lamp, 600 candle-power hours, per gallon, horizontal measurement.

Electric current, glow lamp, 3.5 watts per candle-power hour, horizontal measurement.

Electric current, open arc, 1 watt per candle-power hour, spherical measurement.

Electric current, inclosed arc, 1.5 watts per candle-power hour, spherical measurement.

Gas	650 B. T. U. per cubic foot.
Kerosene	150,000 B. T. U. per gallon.
Soft coal	30,000,000 B. T. U. per ton.
Hard coal	27,000,000 B. T. U. per ton.
Electric current ...	3,411 B. T. U. per kilowatt hour.

RELATIVE COST PER 1,000 CANDLE-POWER-HOURS.

Gas, open tip	33.3 cents.
Gas, incandescent burner	5.0 "
Kerosene	16.6 "
Electric current, glow lamp	35.0 "
Electric current, open arc	10.0 "
Electric current, inclosed arc..............	15.0 "

Of course, electric current is often sold for less than 10 cents per kilowatt hour, and especially for arc lighting, but arc lighting has serious limitations, and has never been a competitor except for certain classes of illumination. Gas at $1 per 1,000 cubic feet, if used in incandescent lamps, is an unassailable competitor as far as economy is concerned, and if the gas company could furnish incandescent lamps and supplies free, gas would still be the most formidable competitor in lighting from the standpoint of economy even if sold at $2 per 1,000 cubic feet.

RELATIVE COST OF HEAT, PER MILLION B. T. U.

Gas	$1.54
Kerosene	0.66
Soft coal	0.133
Hard coal	0.296
Electric current	29.02

Gas at an ordinary selling price is a competent competitor for lighting, and virtually the whole lighting business is at the gas company's command as far as economy is concerned, but is it not apparent that every decrease in the price of fuel gas opens up a larger field of possible consumption, and generally with a profit of everything above your operating expenses? Let us assume that our sales of illuminating gas are so meagre that we would have to get $2 per 1,000 cubic feet if we had no other business, and at this price we could sell no gas for fuel purposes. Our interest charge in this case might be $1 per 1,000 cubic feet. Now let us

assume that we could double our sales of gas by making a rate of \$1.25 per 1,000 cubic feet for fuel gas, and that the 25 cents profit on these sales for fuel purposes would enable us to reduce our price on illuminating gas to \$1.75. Surely the illuminating-gas consumer has no just complaint, and while the average price would be \$1.50 per 1,000 cubic feet, I think you will all agree with me that if we sold all our gas at a uniform rate of \$1.50, our profit would either be less or we would have to get a higher price for our gas, as a rate of \$1.50 for fuel would curtail more fuel gas business than this rate would create illuminating gas business. I believe that the greatest profit can be made by a marked differential rate in favor of fuel gas, or that the same profit can be securéd by differential rates which average less than a uniform rate which would yield the same profit. The Interstate Commerce Commission advises differential rates on this very same line of reasoning, and economists generally support its position. I therefore conclude that differential rates for illuminating and fuel gas are legal and advisable, and that such a differential rate is more equitable than a uniform rate.

DISCUSSION.

VICE PRESIDENT ANDREWS:—You have heard a very interesting discussion on this important subject, and it is now before the Association for oral discussion.

CHARLES S. RITTER:—I might state that it would not make any difference what we think about it, if the municipality or City Council, or whatever division of the municipal government has charge of it, compels us to sell gas at a uniform rate. In Detroit they have passed a franchise at 70 cents flat and offered payment for bills at that rate. Of course payment was refused, and they were about to institute mandamus proceedings to compel us to accept that rate, but fortunately we enjoined them by getting out an injunction in the United States District Court, and that suit is now pending. The rate fixed by the franchise which the City Council of Detroit passed was 70 cents flat, no discount. Of course, we do not know what the outcome of that suit will be. The Supreme Court of the United States, however, has very recently decided in the case between the Detroit United Railway Company and the City that a contract made with a municipality was valid and binding. That was a case where the City Council passed an ordinance seeking to require the street-railway company to carry

passengers at 3 cents straight. The railway company refused to accept the franchise, claiming the right to operate cars under a previous contract, and the Supreme Court of the United States has decided very recently in favor of the railway company, that since they had a contract with the city the city had to live up to it.

VICE PRESIDENT ANDREWS:—That is a very interesting statement of the case as it exists in Detroit. I have no doubt some other members here have had similar experiences, which we would be glad to have them state.

WILLIAM D. MARKS:—I presume a statement of a case in which a differential was carried too far might be of value to the gentlemen here. In the case of the Fostoria Light Company, I was employed a year or so ago to ascertain, if possible, why they did not make any money. The old gas company was getting $1.75 for gas, and a promoter bought up the natural-gas mains and proposed to combine the two and sell gas for fuel purposes at 50 cents and for illuminating purposes at $1, and after running for a year it was discovered that instead of any revenue accruing from the gas feature of the business it was necessary to constantly put in additional funds to keep it going. The fact of the matter is simply this—and I think Mr. Doherty touched upon that feature in his written discussion—that discounts from any fixed price should be made in proportion to the amount of gas sold to the consumer, not for the purposes for which he uses it, whether it be for cooking or asphyxiation or illuminating. If a man buys a very large amount of gas, it doesn't cost any more to take care of his meter than it does the man who buys a very small amount of gas, and it does not cost any more in an office to send him a bill or to read the meter or to do clerical work, and the consequence is that he really ought to have the gas at a less price. But to come back to my original "mutton," I would say in deference to those owning the Fostoria Light Company, an organized effort was made to see if such a thing were possible as to provide gas at 50 cents, and simply get out even on it. I will say that after 12 months of the most intense labor it was found to be absolutely impossible, no matter how large a quantity of gas you might sell, to ever sell it at 50 cents. The total output, if taken by one concern, could have been sold at cost at about 65 cents, and no profit in it at all. That was the extreme limit of price for the very largest output that anybody could possibly take. The price of coal was: Run of mine, $2, delivered on siding in yard. Slack, which we worked

in at times, was sold to us as West Virginia coal, very rich in gas, at $1.50 on siding.

MR. LITTLEHALES:—I would like to ask the last speaker what was the output per annum and the capital per 1,000 feet?

MR. MARKS:—Gentlemen, you will excuse me for being a little prolix. The promoter assumed that if he sold artificial gas at 50 cents per 1,000, this artificial gas would instantly take the place of natural gas, which had been sold at 25 and 30 cents per 1,000, and that everybody would use the artificial gas as they did the natural gas, so he proceeded to put in works calculated to deliver the greater portion of 180,000,000 cubic feet per year in a town of 7,800 inhabitants. When I stopped the work he then had a daily capacity of 350,000 cubic feet, and the work was stopped by my orders. He was then able to turn out 350,000 cubic feet of gas per day. It was the wildest thing I ever heard of.

A MEMBER:—Was he turning it out into the atmosphere?

MR. MARKS:—The output sold was about 18,000,000, or 2,000 feet per head annually.

MR. LITTLEHALES:—What was the capital in proportion to the gas made? That is what I want to get at because that fixes the price at which gas can be sold more materially than any other one question.

MR. MARKS:—If you are putting in a gas-works property, I should fancy that annually 1,000 feet would mean about $2.50.

MR. LITTLEHALES:—I agree with you thoroughly.

MR. MARKS:—But without revealing the secrets of my clients, I would say that much more than $2.50 was put in.

MR. LITTLEHALES:—Gentlemen, therein lies the milk of the cocoanut.

MR. MCILHENNY:—In reference to the discussion on the subject of "Equity, Legality and Advisability of Charging Different Rates for Illuminating and Fuel Gas," it might be of interest to mention the fact which was referred to, I think a couple of years ago, of a somewhat similar case that was carried to Court in the State of Pennsylvania, and the final decision was that gas could be sold by an artificial gas company for certain purposes at a lower price than it could be sold for other purposes. That is, it could be sold for fuel purposes at a less price than it could be sold for illuminating purposes, but that natural gas could not be sold at a greater price for illuminating purposes than for fuel purposes. That case was carried from the lower courts to the Su-

perior Court of the State, because the Natural Gas Company, which acquired control of the Illuminating Gas Company in the town, wished to compel consumers to only use the natural gas for fuel purposes. So that it increased the price of natural gas to the illuminating price when used for the purposes of illumination, retaining the old price for fuel gas. The citizens of the town resisted that effort on the part of the gas company and carried it to court and won, and in the decision of the court the judge stated that natural gas comes out of the ground without any volition on our part, and it comes out as freely one part of the day as another, and consequently the particular use to which it may be applied can have no bearing upon its source, or its cost. While in the case of artificial gas, it can only be used at a certain time of day or night, and its use would therefore be hampered and limited, and the plant could not be run continuously, and during the day when there was the least demand for gas, the company could certainly sell it at a lower price, and that it would be equitable for the company to do so. That case was decided about three years ago. My own judgment would be that it is very largely a question of local expediency, often, whether a differential price should be charged. But as far as I can see, and the company would be warranted, if the expediency demanded it, to charge differential rates and largely for the reason which the court gave in the case just cited, and I believe if it were ever carried up into the highest courts, the court would uphold the right to do it. The railroads have gone through a vast amount of litigation in this country on that very subject, and they have differential rates. The man who buys a thousand-mile ticket can travel more cheaply than the poor man who cannot buy it; and certain classes of freight, also, which, you might say, are equally perishable so that that feature does not enter into it at all, are charged for at different rates. And that practice on the part of the railroad companies has been upheld so far. Therefore, by analogy, I should say that gas companies certainly can do the same thing.

Mr. Andrews:—I would like to ask how far that case was carried up in Pennsylvania, Mr. McIlhenny?

Mr. McIlhenny:—It was carried up, my recollection is, to the Superior Court. They now have a Supreme Court. It was not carried further than the Superior Court, which has jurisdiction of a certain class of cases.

MR. ANDREWS:—That is a very interesting point which Mr. McIlhenny has brought out, as it shows the trend of decisions so far as the legal features of the question are concerned in other states, and of course, it would have a bearing in this state also, as a precedent. We would like to hear from any one else, if they have anything to say on this subject.

MR. EYSENBACH:—Mr. Doherty says that the ideal towards which we ought to work is a uniform load throughout the 24 hours. I would like to ask him if the day load becomes larger than the night load, would he be in favor of charging less for gas used for light than he would for fuel, in order to bring about that uniform load?

MR. DOHERTY:—I am going to request the privilege of closing this discussion, and I will answer all these questions at that time, with the permission of the members.

J. D. SHATTUCK:—The point occurs to me, Mr. President, that we cannot discriminate in suburban districts. For instance, we are located in a large city where the rate is $1.00, and in another territory we are supplying gas at a rate of $1.25. We are going to try and maintain the $1.25 rate based on the greater cost of distribution. I do not know exactly where we will land on that point.

MR. PERKINS:—I might add that we have a similar condition of affairs to those spoken of by Mr. Shattuck. We have an outlying district, but we are allowed to charge a higher rate by franchise, and so I don't think it enters into the question so far as our situation is concerned.

A. P. LATHROP:—Mr. President, I do not see how anybody is injured as Mr. McMillin suggests in his letter, by a different rate being given for a special purpose. I do not think it is fair to discriminate by charging one man $1.00 for illuminating gas and another man 80 cents, but if they all pay the same price for lighting, and others get a special rate for a special purpose, and all of them have that privilege, I don't see how anybody is going to be harmed at all.

MR. LITTLEHALES:—Mr. President, the greatest and most marked instance of discrimination is in the fact that railroads carry dead freight on freight trains for about one-tenth of the rate that they charge for live freight. Isn't that a discrimination? If discriminations are to be abolished, then I presume that human beings should be carried for the same rate as dead freight—so

much per ton. That is a case of a very marked discrimination in my notion.

VICE PRESIDENT ANDREWS:—Before turning the matter over to Mr. Doherty for final answer, I would like to ask Mr. Franklin how the difference in rates has worked out in Cincinnati, as a general proposition? I understand that they had quite an amount of business at the 75 cent rate, where they now have a rate of 50 cents.

MR. FRANKLIN:—We charge 75 cents for illuminating and 50 cents for fuel, and I may say that we are only sorry that we can't get 75 cents for all we sell.

VICE PRESIDENT ANDREWS:—Possibly you do not catch the point of my inquiry. I understood that there was quite an amount of business at the 75 cent rate before the change in rates, and what I intended to inquire was whether those receiving gas at that rate before, have now changed over to the 50 cent rate, or still continue at the 75 cent rate, requiring two services.

MR. FRANKLIN:—By reason of the expense which would have to be incurred in making changes, a great many are still continuing at the illuminating price, and we fully sanction their ideas of economy.

MR. PERRY:—Mr. President, in regard to comparison between railroad rates and gas rates, would it not be fair to take into consideration a plan adopted in railroad rates—that is, the theory of fixing a rate which the traffic will bear. Compare the rate with what the traffc will bear in gas consumption. I would like to inquire whether or not the two things could not be compared in the same way.

VICE PRESIDENT ANDREWS:—If there are no further remarks, I will ask Mr. Doherty to answer a few of the questions that have been put to him.

HENRY L. DOHERTY:—The first question I want to answer is the question put by Mr. Eysenbach. He asks if I would charge more for the day lighting than night lighting. I make no distinction with reference to the time the gas is used. I hold that that consumer should have the lowest rate which occasions the least demand and uses the most gas. That is, if he demands 100 cubic feet per hour, if that is his maximum rate of demand, and he uses it for ten hours per day, he should have a lower rate than the man who demands 100 cubic feet per hour or at that rate as a maximum and only uses it for two hours per day. Now, so far as daylight

consumption and night consumption is concerned, I do not see why you should divide between before and after 6 o'clock, as the thing you must provide for is your instantaneous demand and no matter where it occurs, if you have five minutes of the day when you must send out gas at an excessive rate, then that is what you have to provide for. Now another speaker asked why it should not be charged at what the traffic will bear. That was the point I was trying to bring out by showing that artificial gas for illuminating purposes is already down to where it will compete with all forms of illumination except natural gas and daylight. We are already furnishing it so cheaply that we can command commercial lighting in competition with every other form of illumination except natural gas and daylight and arc lights where they are sold very cheap. On the other hand, selling gas for fuel purposes at $1.00 per thousand is equivalent to selling coal at $53.00 per ton. So we cannot hope to compete with coal to the same extent we could compete with electric current or kerosene, or other illuminating agents. We cannot hope to compete with fuel agents to the same extent as we can with illuminating agents.

Now, I do not hold that differential rates are equitable, but I do hold that they are more equitable than a uniform rate. A uniform rate is absolutely inequitable. Assume that I have a consumer who uses absolutely no gas at all. I have to read his meter. I have to provide him with a meter, and make out his bill; keep track of his account; stand the depreciation and repairs on the meter, as there are depreciations and repairs even though the meter is not used. The cost for supplying that man with gas will be infinitely great. If he used 1,000 cubic feet of gas per year, and it costs me $6 per year to take care of his account and maintain his meter, that gas has cost me $6, plus the cost of manufacture, and I have only $1 to show for it.

Now, as far as giving discounts on the basis of the quantity of consumption is concerned, I see no way of doing that without making an arbitrary dividing line, and that means that one consumer can pay more for a less amount of gas than another consumer for a greater amount of gas. That is surely inequitable. Say we charge $12 per year for "Readiness to Serve," and he uses 1,000 feet of gas per year, selling gas at a uniform rate of 50 cents, then he would pay $12.50 per 1,000 cubic feet, and if he used 2,000 cubic feet he would pay $12 per 1,000 cubic feet. Then he would get a constantly descending rate, while by a discount on the

quantity of consumption you would not have a gradual descending rate, but a rate descending by steps, which means that if your dividing line is 50,000 cubic feet the man who uses 49,500 feet will have to pay more than the man who uses 51,000 feet. Now the main point in this discussion is to justify this differential and on the ground that the fuel business or traffic, as one speaker has referred to it, will not stand a high rate, and if you get any price above your operating cost, your fixed charges which are occasioned by that class of business and that class of business alone, anything above that you can apply to all of your business, and in that way can sell your illuminating gas for less.

Now I am confident as you reduce the price of fuel gas you open up enormous fields of application. As you reduce the price of illuminating gas you open up a very limited field of consumption. You open up a field of carelessness in the one case and in the other case a field of real possibilities.

If you are selling a man gas at $2 per 1,000 he will be very careful how he uses it, but if you sell him gas at $1.50 he is less careful, and at $1 he is still more careless. However, when you commence to reduce the price of fuel gas from $2 per 1,000 you are constantly going to that point where a higher efficiency of gas fuel appliances will make it possible to use it instead of coal, although on the basis of heat energy you are selling gas at about 12 or 13 times as much. I think the company is benefited and I think the consumer is benefited by marked differential between the price of illuminating and fuel gas.

Now some lighting business may be just as desirable as fuel business. Take it at a 24-hour consumption. The lighting business would be very desirable. On the other hand I can conceive of fuel-gas consumption, instead of occurring three times a day as cooking gas is apt to occur, might occur once a year in most enormous quantities, but we cannot make fine-haired distinctions in this matter. As a rule fuel gas does not produce the same maximum demand as lighting gas does for the same quantity of consumption. Practically all your lighting gas is sold in the early evening, while fuel gas starts in at 6 o'clock in the morning and it really never stops through the 24 hours, and with a great many consumers, it never stops from 6 o'clock in the morning until 11 or 12 o'clock at night, while with lighting gas, as a rule, they turn it out by 9 or 10 o'clock in the evening, except one jet just allowed to run in the bath-room or the hall, or something of that sort.

Vice President Andrews:—Gentlemen, you have heard some very interesting written and oral discussions, and I know that we are all indebted to Mr. Doherty for bringing this matter before us in the shape that he has.

QUESTION BOX.

President Doherty, assuming the chair, said: We intended to cover to-day the commercial portion of this program. When we finish that perhaps we had better take up some engineering subjects, because otherwise we will have more than we can do to-morrow. I now suggest that we take up such queries in the question box as relate to the commercial branch.

Question 4. In a plant carbonizing 5,000 tons of coal per annum, which is more profitable, the concentrated or sulphate ammonia plant?

Mr. Andrews:—We are running quite a large plant at Hamilton, and making concentrated liquor entirely. Before going into it we, of course, investigated the matter as thoroughly as we could, and found that the opinion of most people was that the wear and tear and depreciation of a sulphate ammonia plant was so great that it more than offset any possible advantages which might be obtained over concentrating the liquor. For that reason we did not adopt it.

George Light:—We have been operating a sulphate plant about 15 or 18 years, and we have found of late years that we did not have much trouble with it. Some years we had an advantage over the concentrated, and then again they would get a better price than we. We still consider it satisfactory, and in fact we are going to enlarge this year.

Mr. Littlehales:—That question seems more largely one of where you sell your product and for what purpose you sell it. Of course if your product is going to be used for the manufacture of fertilizers it would be almost necessary to have it in the form of a sulphate. If you are going to use it, for example, for soda-ash manufacture or anything of that sort, it would be very much cheaper to concentrate it into liquor. So that I think it depends largely upon what the product is to be used for.

Mr. Cline:—I should think it would depend upon the market price of the two products.

Mr. Littlehales:—If it were for fertilizing purposes they would have it in the form of sulphate almost of necessity, otherwise there would be a loss of ammonia. On the other hand if it were for the purpose of soda-ash manufacture they would have to have it in a liquid.

President Doherty:—Here is a question that is purely commercial and not engineering.

Question 6. Can you legally shut a consumer's gas off for non-payment of a disputed bill?

If that word "legally" were not in there it could be answered much more easily.

Mr. Lloyd:—I think that has been settled in a case just recently tried in Montreal in which it was decided by the highest court in Canada that you can not shut off a consumer for non-payment of a bill.

President Doherty:—That does not seem to be this exact question. This question is "Can you legally shut a consumer's gas off for non-payment of a disputed bill?" or in other words, where the accuracy of the bill is in dispute.

Mr. Lloyd:—They would have to prove their case. They would have to prove that the gas was consumed, of course.

A Member:—It has just been decided in New York State that you cannot shut a person's gas off for a preceding bill in the same house, as for instance, a new tenant moving into the house. A case was recently decided in New York where large damages were collected.

President Doherty:—I should say not.

Charles S. Ritter:—I was just going to suggest that the consumer's recourse is to pay the bill under protest. Then if it is decided in his favor, he has an opportnuity to recover.

Mr. Stone:—The question came before us a little while back which we referred to our attorney to ascertain how we would stand in the matter legally, and he informs us that in case of a disputed bill you cannot shut the man off if he is willing to guarantee his future bills. As long as he is willing to pay future bills you cannnot shut him off, but your only recourse is to sue him for the amount of the disputed bill if he wants to hold out, and you have no right to shut him off, and if you shut him off on a disputed bill, he could bring an action in damages against you.

President Doherty:—If there is nothing more on that subject, here is another question more largely of a commercial nature than anything else:

Question 8. What is the most satisfactory meter (other than the proportional) having a capacity of 2,000 to 6,000 feet per hour, for measuring gas supplied to gas engines?

I will call on Mr. McIlhenny.

MR. MCILHENNY:—I should think, Mr. Chairman, if it were in a location or point where they would have no use for a station meter that the most satisfactory solution of the problem would be the use of a battery of large dry meters, and those meters then could be used for other purposes, and it would also be of less trouble to the consumer as well as the company if at a distance from the gas-works.

MR. WHYSALL:—I would like to ask the last speaker what he means by the statement that the meters could be used for other purposes.

MR. MCILHENNY:—What I meant was that they could be used for other consumers. It necessarily involves an investment. I have known of a similar case where a company did not want to install a station meter for a large consumer because the business was not of the character that they thought it could be afforded, and they also would not want to put in a very large dry meter even where the case was not so extreme as this and my suggestion was that if they would put in two or three smaller meters they would then have a meter which they could use at other points or for other consumers if they should lose that one.

MR. WHYSALL:—Then you are assuming that the equipment is temporary?

MR. MCILHENNY:—No, not necessarily, but I am assuming as has often been found to be the case from experience that with the changes being brought about, the tendency is for every large consumer to supply their own lights or their own fuel whichever it may be. Very frequently large meters have been displaced and the company would have no use for them, but if they should put in a sufficient number of moderate sized meters, for instance, instead of one 300 lights, they should put in two 150 lights, then they would have a commercial article which they could use in some other place and supply gas to this large consumer through two moderately sized meters instead of one large one. I would recommend in this case the use of a sufficient number of meters of about 200 lights capacity, to give the required amount of gas, of the ordinary dry type.

Mr. Littlehales:—Has any gentleman present ever had any such experience with the proportional meter working under low pressures? I have had some little experience with it and it has been most unsatisfactory. One can understand that a proportional meter will work very satisfactory under a high pressure. For example, take natural gas at a pressure of 100 pounds. Suppose it takes one pound to drive that meter. It is hardly noticed, whereas when you come down to low pressures the friction on the proportional meter with the low pressure is so much in proportion to the pressure that it does not register accurately. I have had two or three instances where I could not do anything whatever with the proportional meter on that account. Now if any of you gentlemen have had or know of anyone who has had satisfactory experience with the proportional meter under low pressure, I would like to hear it.

J. D. S. Neeley:—I probably could not answer this question as to the very low pressure, that is, on what would probably be an artificial pressure, but we use a great many of them on natural gas and find them eminently satisfactory. We believe they measure accurately, and give as good satisfaction as any meter could possibly give. And they even do when we are down to one-half ounce pressure. We do not find any difficulty in their measuring accurately. I have never tried one on artificial gas, but I think they are a very good meter, and I believe would measure accurately on both pressures.

President Doherty:—Mr. Malone, did you ask this question, No. 8?

Mr. Malone:—Yes, sir. We had occasion to install a gas engine of 200-horse-power and we did not know what style of meter to adopt. We had intended to adopt the proportional. I wrote around and found that the experience of some people who used them had not been eminently satisfactory, and I concluded to ask the question for that reason. I put the same question before the Wisconsin State Association, which was recently organized, and nobody seemed to be able to answer the question, and I therefore concluded to send it in here. Since then we had occasion to connect up in multiple five equitable meters, made by the same parties who make the proportional, I believe, and we found under a half load that they give very good results. They were connected up on the same plan that Mr. McIlhenny spoke of. The cost of them was much less than the ordinary dry meter, and they

pass the gas very freely and register very closely. They had a capacity of 1,200 feet each, which would be 6,000, and the maximum demand on the engine would be 5,600, so that we had 400 for a margin to work on.

PRESIDENT DOHERTY:—I think I remember passing on that purchase, and the thing which influenced us mostly, as I remember it, was the space and cost.

MR. MALONE:—Yes, the space is very much less, probably 50 per cent. less than the smallest proportional meter, as I remember it.

PRESIDENT DOHERTY:—Now here is a question that ought to interest all of the members:

Question 12. What method should be employed in comparing station meter with consumers' meters to obtain the nearest correct loss of leakage and condensation?

MR. LLOYD:—Mr. President, we do not cut off our consumers' quantities and the station meter on the first of the month, but we have what we call a mid-date for the meter reading, and that mid-date is determined as closely as possible with reference to the middle line of output for the time in which the meters are read. For instance, it will take us a portion of two or three days to read all the consumers' meters. And we strike a point as nearly as we can estimate it, which is the middle of those three days, and the station meter is read at the same time, and comparisons are made between those mid-dates.

MR. MULHOLLAND:—Would not the business district of the town enter very considerably into that as to which date he happended to read that on? I would like to inquire whether you divide your business district equally during that specified time, or do you take that in during the first half or the latter half?

MR. LLOYD:—We do not take the mid-date necessarily on the middle line between the beginning of the reading and the ending of the reading. We use our best judgment, which is as near as we know how to estimate it, as to the consumption which would occur in that half or the other in that middle line. Suppose, for instance, we take three days as the time within which the meters will be read. We may not take a day and a half from the beginning or the end as the mid-date. It may be two days off or one day off, according to the districts we are reading. It is purely a question of judgment.

President Doherty:—I think that is probably the best answer we can get to that question. It is the way I have often thought of treating it, and then keeping a gas-stock account to compensate for all differences between the amount used or the monthly report of gas manufactured and the real amount manufactured during the month.

Question 13. What success are gas companies having with the gas arc lamps, and how is the best way to introduce them?

Mr. Andrews:—I believe most thoroughly in the adoption of gas arc lamps as being the only way in which we can get back the lighting business which has been taken from us to a large extent in past years by electricity. After the first cost of gas for lighting is reduced so much per unit, as shown by Mr. Doherty's figures, people can afford to have a great deal more illumination than they ever had before. This also increases your consumption very largely in a very short time after the lamps are introduced. This is the way it appeals to me, that the gas company can put these lamps in at a very small rental—in fact, simply maintenance charge you might say, as the increase in business is sufficient to justify it. In our case we put in something like 200 since the first of the year, and find the average consumption is about 2,000 feet per month per lamp. This is a larger average than other classes of consumers that we go after, for instance, stoves, and the amount paid out for the services and the meters and everything of that kind will greatly exceed the cost of the gas arc lamp. So I look upon it as a very good investment, even if you do not get anything more than the actual maintenance charges on the lamp.

Mr. Franklin:—I might say a word in regard to gas arcs. In 1899 we started out to supply gas arcs in competition with electric. The first year we put out 1,600 of them on a year's trial. Last year we started out to collect the bills for them, and we took down probably 55 or 60 out of the entire output. This year we are putting them out at $1 per month, payable in one year, or $12 a lamp.

President Doherty:—You are selling them, and not renting them?

Mr. Franklin:—Selling them outright.

Mr. Lathrop, being called on by the chair, said: Mr. President, I think that advertisement on the wall of this convention room shows what can be done with the gas arc lamp. (The advertisement referred to was as follows: "The Humphrey gas arc, the only gas arc used by the People's Gas Company of Chicago; 10,000

placed in Chicago since October 1, 1901.") I must say, in going through Chicago last evening, I was surprised to notice the extent of the use of the gas arc lamp. I find that all classes of business are using it, and it must certainly be making great inroads in other forms of lighting. In Minneapolis the gas company has in, I think, about 1,200 of them, and they are meeting with great success there.

MR. NEELEY:—I think the gas arc lamp is the salvation of the gas company. I believe in localities where they do not have municipal ownership of an electric light plant that the gas company by the use of the gas arc lamp can put the electric light plant out of business if they push it right. I think one great mistake a gas company makes is that they will buy an arc lamp for $8 and then try to get the consumer to pay them $12 for it. Now that is a poor way of competing with the electric light company. The electric light people buy the lamp, put it up and maintain it. Of course, they get a little more money, but it costs them more to get their current and maintain it. I believe if the gas companies would adopt some plan to put out arc lamps and maintain them that they would increase the sale of gas enough to more than recompense them. We have been experimenting a little with it in our town and we find it builds up trade. They will use more gas, and we are getting more money out of it. I believe the time is not far off when we will not only be giving arc lamps to the consumer, but we will be furnishing mantles free, and will be doing the business of all the towns if it is properly pushed. There is no question but that gas light is *the* light, and can be made the light in every town, and especially the smaller sized towns of the country. Of course, it takes some energy and some hustle. We will have to have a little "scrap" once in a while with the municipal council, but that kind of exercise merely broadens you, you know. I have in mind one town in particular which, from the lighting standpoint, is an ideal town. That is the little town of Sidney, O. We own the natural gas, the artificial gas and the electric light, so that we do not have much trouble in that town.

PRESIDENT DOHERTY:—Question 14. What value should we place on our retort carbon? The fellow was optimistic who asked that.

A MEMBER:—I think the other fellow fixes the value of that.

MR. LATHROP:—I do not see that it makes much difference what value we place upon it. The important question is what can we get for it?

C. A. SCHWARM:—The reason I asked that question was this: We had quite a little stock of carbon at Lorain, and I took it up with several of these electric concerns, that is, carbon manufacturers, and had various offers; one of them offered me $11.50 a ton, another offered me $13, and another offered me $15. I took the $15 man's offer. Just about two or three days after that I was talking with one of the engineers in the United Gas Improvement Company, and the conversation drifted to carbon. He asked me what we were getting for carbon and I told him about $15 a ton. He said, "You are selling it too cheap. We are going to hold our carbon until we get about $25 per ton. The United Gas Improvement Company figure it is worth about that much to the carbon manufacturers." What I wanted to bring out was if we can get $15 or $25 a ton everybody should be aware of that fact.

PRESIDENT DOHERTY:—Question 15. Why not suggest to the publishers of our standard gas papers to reduce the size of same to more nearly conform to size of standard magazines of the day; the advantages in favor of the smaller publications being apparent to all?

MR. SCHWARM:—I also asked that question. I cannot see why we could not have our gas journals cut down into smaller volumes that are handy to put on your desk or to bind in good shape for the library. The tendency all along the line to-day seems to be towards decreasing the size of all the trade or technical journals, and I should think if the Associations would suggest that to our publishers there would be no reason why we could not have the advantage of a book smaller in size and better adapted for reading purposes.

MR. LITTLEHALES:—The last speaker is not like some of us who have to carry glasses on our noses. If often happens that the reproduction of plans or of the apparatus illustrated in these technical papers will occupy a full page even as large as they now are, and then the figures are small enough, so that I think it would be utterly impracticable to get the full advantage of some of the plans that we want to see reproduced if the technical journals should reduce the size of their pages to the ordinary magazine size.

MR. PERRY:—In response to what the last speaker has said it might be suggested that in a case of reproduction of cuts they might be bound on one side and folded in thus permitting the cuts to be of any size desired.

PRESIDENT DOHERTY:—I do not believe there would be much chance, gentlemen, of getting the publishers of these journals to seriously consider any change unless they knew what percentage of the gas fraternity wished such a change to be made. If you are interested enough in it I would suggest that all of those in favor of reducing the size to the ordinary magazine size would signify the same by holding up their hands and I will count them, and then I will request those who desire no change in this regard to indicate that fact by holding up their hands.

The vote on the above question was then taken and stood 31 to 3, about 40 or 50 members not voting.

PRESIDENT DOHERTY:—That will reach the publishers of these journals without further comment.

PRESIDENT DOHERTY:—Mr. Eysenbach will now read the Wrinkle Department, and we will discuss each wrinkle as presented.

WRINKLE DEPARTMENT.

E. E. EYSENBACH, EDITOR.

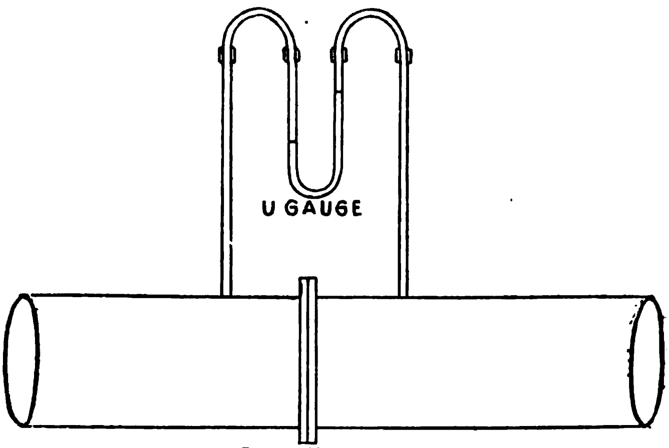
I. METHOD OF TAKING SCALE OUT OF GAS-ENGINE CYLINDERS.

C. W. Andrews gives a description of the following method for taking scale out of gas-engine cylinders where hard water is used: In our Westinghouse engine, on which we use this device, there are several plugs on top of the jacket and also a pet cock for draining at the bottom. After removing the top plugs we drain off the water from the jacket, and after closing the lower pet cock fill the jacket with commercial muriatic acid. This is allowed to stand in the jacket until the decomposition of the scale, with the attendant evolution of carbonic acid gas is completed, as far as that amount of acid is concerned. It is then drawn off through the lower pet cock, and the jacket thoroughly washed. If the scale is light one application is generallly sufficient. If not sufficiently removed the process is repeated until fresh acid does not cause any further evolution of gas. In this way the necessity of taking the jacket apart is usually avoided.

II. A RESISTANCE METER.

Donald McDonald gives a description of a device for measuring the amount of gas, air or steam passing through a pipe without a meter. This device is called a resistance meter, and is constructed as follows: "The pipe is parted at any convenient point,

and a sheet-iron diaphragm inserted, the diaphragm containing one or more holes of known size. The size of these holes must be governed by the amount of resistance which can be produced in the pipe without inconvenience. The pipe is then tapped before and after the diaphragm which causes the resistance, and ½-inch pipes are then led to any convenient point for taking observations, when the two pipes are joined by rubber tubes to the two ends of a U gage filled with water. The reading of the U gage will always show the amount of resistance which the diaphragm causes to the flow of gas through the pipe. By taking and recording frequent observations of this resistance, the daily delivery can be ascertained



NO. II. RESISTANCE GAS METER.

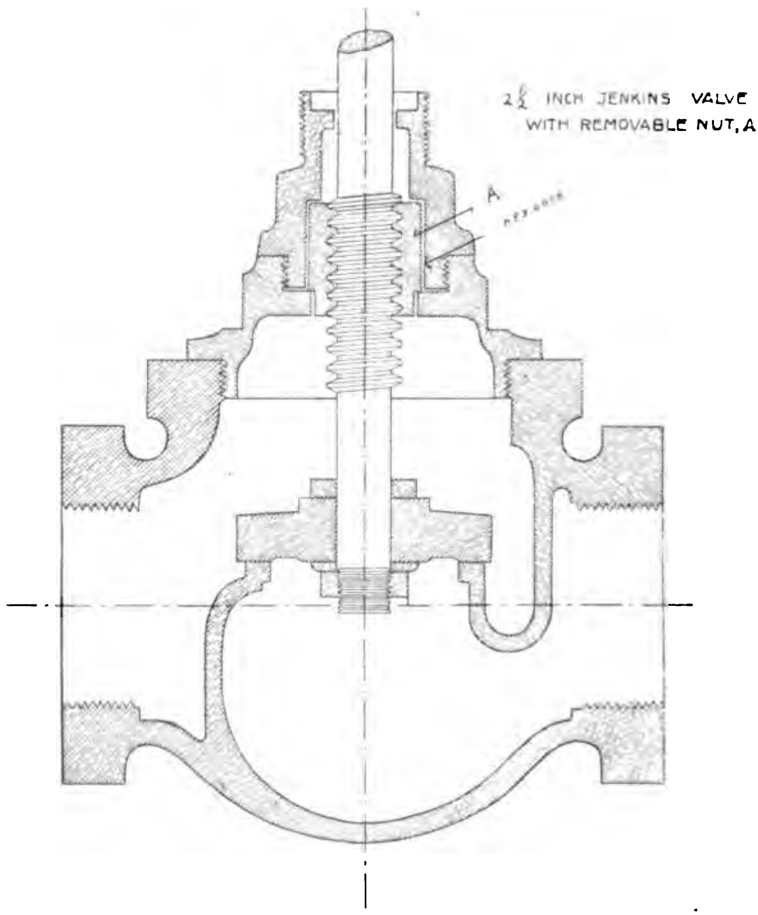
very closely, while for the purpose of ascertaining instantly just how much gas or air is actually flowing through, the device is a better one than any other form of meter. We have used a device of this sort for the last ten years, and have always found that it is exceedingly convenient and always accurate. For the information of any one intending to construct such a gage, I will say that a sheet-iron diaphragm with a circular hole 3½ inches in diameter passing 300 feet per minute of carbutated water-gas will cause a resistance of 2 inches of water. If the resistance is multiplied by four, the delivery will be doubled. With this for a basis, a meter can be constructed to meet any conditions of delivery desired, and resistance which can be tolerated that are likely to arise, and a

table can be made up by means of which the resistance in inches and tenths can be read into cubic feet delivered per minute."

PRESIDENT DOHERTY:—That is based upon the law that the flow of gas through an orifice is as the square root of the pressure. Any comments? If there are no comments, you may read the next.

III. REPLACEABLE NUT TO BE USED ON THE REVERSE STEAM VALVE OF GENERATOR.

W. C. Morris gives the following: "These valves are operated so frequently that the ordinary bonnets wear out in a very short



NO. III. STEAM VALVE WITH REPLACEABLE NUT.

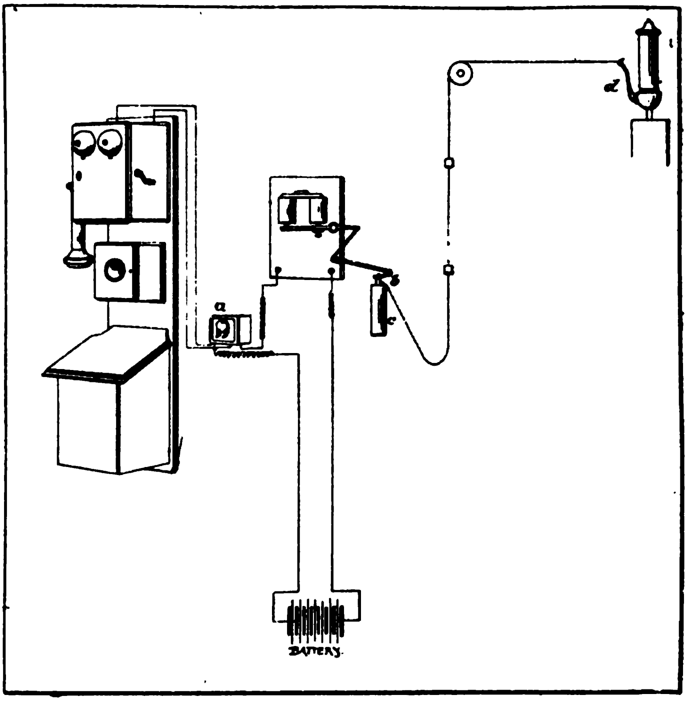
time, and need to be replaced at considerable expense and labor. The bonnet which is shown on the sketch is made all of cast iron, with the exception of the stuffing-box nut, which is not shown. The hexagon nut, A, is replaced as it becomes necessary by wear, as well as the stem, but the expense of replacing this nut is very much less, amounting to about 8 or 9 cents per change as against about $1.50 for a complete bonnet."

IV. A COKE SCREEN.

Ernest F. Lloyd gives the following description of a coke screen: "It is now in use at a number of works, and has been successfully employed at the works of the Adrian Gas Company, Adrian, Mich., and consists of an elevated run-way up which the coke as taken from the retort house is wheeled. At the top it is dumped over the side of inclined screens made of common ¾-inch gas pipe, the ends flattened out and nailed to ordinary timber supports, being set on an angle of 45 degrees. The coke is dumped on the upper end of this screen, which is about 7 feet long on the slant, and in running down that distance, practically all of the coke which will pass between the pipe bars does so, and falls to the bottom. An extension of the same idea can readily be had by another screen set below the first one and at an angle of 45 degrees to it, and being composed of about ½-inch pipe, set closer together, will separate the coke breeze from the crushed coke. At Adrian, these screens are mounted upon a frame, which runs on a track, the end of the elevated run-way being extended on the level, so that by moving along the screen, it can be made to discharge into different bins, and thereby serve a considerable-sized coke shed."

V. TELEPHONE CONNECTED WITH STEAM WHISTLE.

L. W. Wells gives the following: "Usually at a gas-works, especially in or near the retort house, there is much noise, and a call from the ordinary telephone bell cannot be heard at times by the workmen, and in consequence much time is lost at the uptown office in communicating with the works. The device illustrated in the drawing in connection with the telephone is the result of an effort to shorten the time in getting some one to the telephone. When a call is made from the central station, the drop, *a*, falls, releasing the trip on which the weight is hung at, *b*, causing the weight, *c*, to fall which opens the valve at, *d*, thus blowing the



NO. V. AN AUDIBLE TELEPHONE CALL.

steam whistle until the telephone is answered; at the same time the device is readjusted, ready for the next call by the party answering. No battery power whatever is used only when the drop, *a*, is down.

VI. CEMENT FOR PIPE JOINTS.

George Light sends the following description of a cement used at his works: Take ordinary pine tar and mix it with dry oxide of iron. This putty will make as good a joint on a faced or rough flange joint as red-lead putty, at one-tenth the cost. It will not harden as soon as red lead, but is very adhesive under pressure.

VII. COKE WAGON.

John McIlhenny sends the following description of a coke wagon: At a plant in a city of 12,000, the hot coke is conveyed from the retort house to the coke shed, some distance

away. The wagon used for this purpose has been in use for about 18 years, and is in splendid condition to-day. The wagon, instead of being made of sheet iron, is made up of flat iron strips, something on a basket idea. The strips are about ¼ inch by 1¼ inch, being riveted together where crossing, the openings being 1 inch square. The axles and wheels have been renewed several times, but the identical body is in use to-day as made, certainly 20 years ago. The same idea might be applied to coke wagons and coke barrows, and possibly in a less expensive way than the bar construction, by using a perforated sheet iron of a greater thickness than the ordinary sheet iron now used.

DISCUSSION.

PRESIDENT DOHERTY:—Any comments on that wrinkle? I was thinking that ¼-inch bars would make a very heavy wagon.

MR. MCILHENNY:—It wasn't unduly heavy.

PRESIDENT DOHERTY:—How do you explain its long life?

MR. MCILHENNY:—I explain its long life by the fact that it could not hold any water after the coke was dumped out, and it could not be heated so highly by having a current of air through and around the bars.

PRESIDENT DOHERTY:—That would create combustion, would it not?

MR. MCILHENNY:—It would make the coke a little bit hotter, but the air would keep it cool on the same principle that bars in a furnace are kept cool by the water underneath. The thing of interest to me was the fact that this coke wagon was in use for about 18 years, and was never replaced once, and the only way I can account for it is because it had this open-work construction.

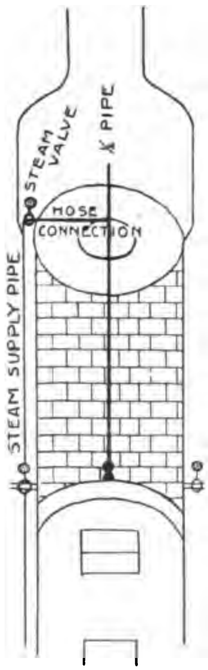
MR. DUNBAR:—I want to ask if the idea suggested by you that the openings would cause increased combustion, whether the loss in weight of coke would not far overweigh the advantages to be derived from such a wagon?

MR. MCILHENNY:—I did not go into an analysis of it at all, but I should think the difference in combustion of coke would not be material, as it is quenched in such a short time that it would not be appreciable.

PRESIDENT DOHERTY:—If there are no further comments, we will take up the next wrinkle.

VIII. CLEANING SUPERHEATER.

D. S. Milne gives the following suggestion for cleaning superheater before starting machine in the morning: A ½-inch pipe with flexible steam-hose connection, is passed down between the brick in the superheater and the steam allowed to escape in passage. The operator passes this pipe many times into the superheater each morning, cleaning same thoroughly. The use of this



NO. VIII. STEAM CLEANER FOR WATER-GAS SUPERHEATER.

device adds materially to the good work of the machine and life of superheater. Four 1-inch steam connections made just above the arch used for blowing dirt out of superheater can be used any time between runs.

DISCUSSION.

PRESIDENT DOHERTY:—Any comments on that, gentlemen? What do you think of the idea, Mr. Shattuck?

MR. SHATTUCK:—I do not quite understand where he applies the pipe there.

Mr. Eysenbach:—I think he lowers the pipe down in the brickwork.

Mr. Shattuck:—And the flexible hose does not come in contact with the brickwork?

Mr. Eysenbach:—No; he has a long ½-inch iron pipe to let down into the brickwork, and that is one in which connections are to be used at any time.

Mr. Shattuck:—I think considerable dirt would be blown out of the machine that way.

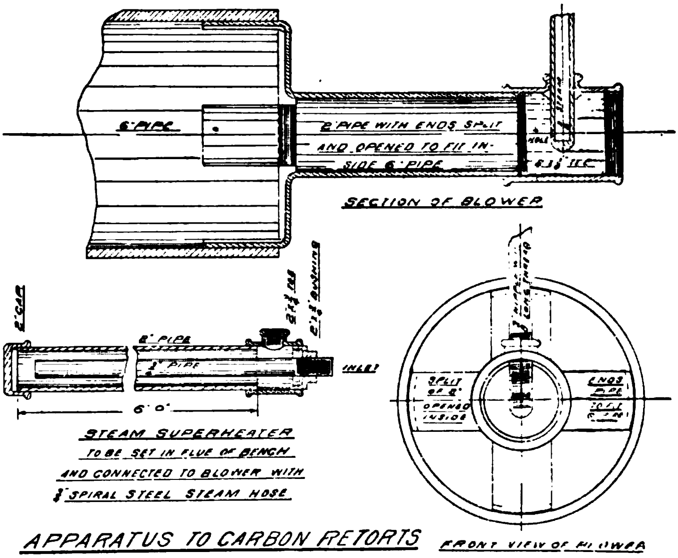
President Doherty:—I don't see how he can get around his checker work to amount to anything.

Mr. Shattuck:—If his checker work runs back and forth, I don't see how he can get down to it.

IX. APPARATUS FOR DECARBONIZING RETORTS.

John M. Robb gives the following method of decarbonizing retorts: Material required is, a piece of old 6-inch wrought-iron pipe about 9 or 10 feet long; a piece of 2-inch pipe 12 inches long, one end threaded and the other end split and opened out into four prongs which will fit tightly into the 6-inch pipe; one 2 inch by ⅜-inch tee; one ⅜-inch nipple with one end closed over, a ¼-inch hole drilled in side near closed end, and nipple threaded long so it can be screwed into tee to bring ¼ opening on a line with the center of the tee; a piece of 2-inch pipe 6 feet long; a piece of ¾ pipe 6 feet long and one end threaded 3 inches; one 2-inch cap; one 2-inch by ¾-inch tee; one 2-inch by ¾-inch bushing, and a piece of steam hose about 10 feet long. (¾-inch flexible steel tubing can be bought of Sharp & Klumph, 1104 Monadnock Building, Chicago, for 85 cents per foot, and $1.25 each for couplings. This is far superior to steam hose, and will wear indefinitely.)

The steam superheater is connected with about 4½ feet of its length inside one of the bench flues, and in such a position that the steam hose will reach all the retorts in the bench without breaking the steam connection to the superheater. The 6-inch pipe is shoved into the retort to be carboned and the prongs of the 2-inch pipe wedged into the 6-inch pipe. Steam is now turned on. With 70 pounds steam pressure a very heavy deposit of carbon may be removed in three hours, and by using this apparatus a bench of nine retorts has been carboned in 48 hours, taking one

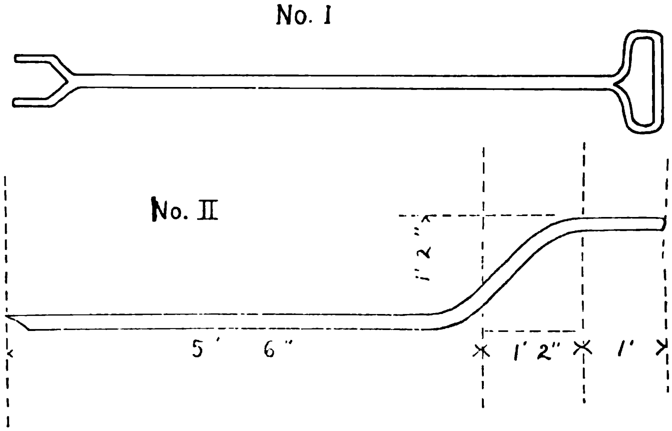


NO. IX. DEVICE FOR DECARBONIZING COAL-GAS RETORTS.

retort at a time, and charging it again before starting on the next retort. The 6-inch pipe will generally last long enough to decarbonize two benches of nine retorts. Cast-iron pipe will not answer.

X. TOOLS.

C. H. Printz describes two tools of great value in the retort house. No. 1, for cleaning and holding in place self-sealing lids



NO. X. TOOLS FOR RETORT LID AND CLINKERING.

of retorts while latch is being placed in position. No. 2, a sword for breaking clinkers loose from the furnace grate bars. The blade is made of 2½-inch by ½-inch iron, and the handle of 1¼-inch round iron.

PRESIDENT DOHERTY:—Any comments on that, gentlemen? I would like to ask how that second tool works; I don't understand it.

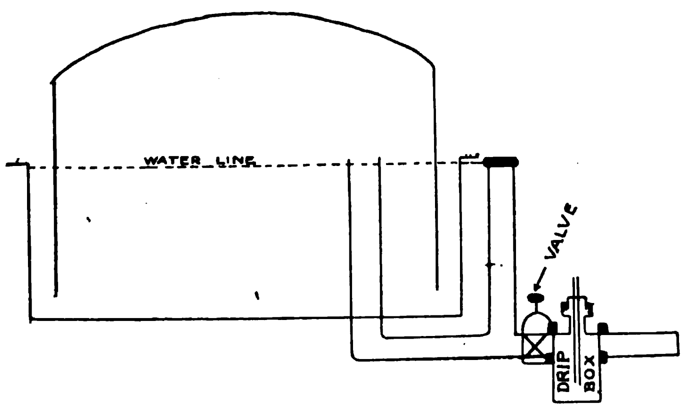
MR. EYSENBACH:—I think it was a special tool for his furnace.

XI. REMOVING CARBON FROM RETORTS.

D. W. Low sends the following: A 4-inch pipe is connected to the blower of our water-gas system run over in front of the benches, dropping down to the mouth of the retort with a 2-inch pipe, then running about 6 feet into the retort with a ¾-inch pipe. By putting on a medium strong blast we are able to take all the carbon out of our retorts in about 8 hours.

XII. FOR REMOVING NAPHTHALINE TROUBLE IN THE INLET AND OUTLET PIPES OF A GAS HOLDER.

Described by M. E. Malone as follows: It consists of placing two tees beyond drips and valves on the horizontal inlet and outlet pipes leading into holder. The side openings on these tees point upwards, and in them are placed two vertical pipes the same height as the inlet and outlet vertical pipes inside the tank. These form a U-shaped arrangement; the outside pipes are capped with a



NO. XII. PLAN FOR WASHING NAPHTHALINE OUT OF HOLDER PIPES.

flange or plug. In case of excessive trouble with naphthaline deposits in the inlet and outlet pipes, the valve on the inlet to holder is closed, and the U-shaped pipe filled with water. The cap can be removed from the vertical pipe on the outside of the tank, and a plunger placed in this pipe and the water churned until the naphthaline crystals are deposited in the bottom of the U-shaped pipe. The plunger is removed and pipe capped up and valve opened, when all the liquid and naphthaline deposit will fall to the drip, which can be pumped out. The same method can be employed on the outlet pipe. This method, of course, can only be used where there are two holders.

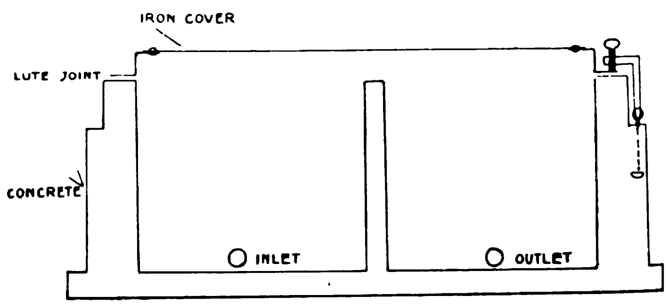
DISCUSSION.

MR. WHYSALL:—I see no reason why you could not use this with one holder. You have an inlet and an outlet pipe and use a by-pass and apply this same arrangement in each one.

PRESIDENT DOHERTY:—I think you could. Any further comments? If not, go ahead.

XIII. PURIFYING BOX.

C. M. Keller sends the following: The sketch shown herewith illustrates a purifying box made of Portland cement concrete plastered with a coat of neat cement. The covers are made of Z bar iron with sheet iron riveted on the top. The joint is made



NO. XIII. A CONCRETE PURIFIER BOX.

with luting. The top is held down by the screw and anchored in the concrete. The round ring shown is anchored into the cement and the fastening hooked into it. The boxes are 10 x 12 inside

measurement with a partition in the center. The gas comes in the bottom of one side and goes out the bottom of the other. There are two sets of trays which are held up by framework.

DISCUSSION.

MR. ANDREWS:—It seems to me that a good deal of money is being spent on the top of that box, which possibly could be saved by putting a concrete top over the whole thing and putting manholes sufficient in size to properly ventilate it after being emptied; and then, putting openings at the side to draw out your spent oxide, rake it out, because the top has to be pretty strong to carry the upward pressure.

PRESIDENT DOHERTY:—Any further comments? I suppose you all endorse this form of box.

XIV. ELECTRIC FAN FOR INCREASING CONDENSATION.

W. A. Baehr sends the following: At the gas-works of Denver we have a series of vertical annular atmospheric condensers in the coal-gas plant. We increased the amount of coal-gas made considerably, and as a result found that we were not able to condense properly. As the cheapest and most satisfactory expedient under the circumstances, we adopted the following scheme: At the upper end of each condenser, on the inside of the air space, we placed a circular pipe which was perforated with numerous small openings. Through these we pumped water, so that it would spray against the inside of the vertical tube. This water running down would, of course, help to cool the gas. Under this series of condensers there is a tunnel running under the building to the outside. At the outside of the building we erected a 26-inch fan, driving it with a 3-horse-power electric motor. By means of this fan the air blast was made to go into the tunnel, and up the inside ring of each condenser, meeting the water spray flowing downwards. This caused considerable evaporation to take place, and we benefited, of course, by the absorption of heat from the gas due to the latent heat of vaporization at that temperature. We were able in this way to pull through the hottest part of the summer, keeping the gas at a temperature of 70 to 72 degrees. Total reduction of temperature of the gas was practically 50 degrees Fahr. The cost of the electric power using 3-horse-power motor was practically $250 per year, constant service day and night.

DISCUSSION.

PRESIDENT DOHERTY:—I might add something about this by explaining that it was not so much the lack of capacity in our condensing plant as it was the fact that no matter how much capacity we had we could not get below atmospheric temperature. We were dependent upon air for condensation as our water had to be pumped from a great depth, and we concluded it was easier to pump air than water, so we allowed the water to run out on the inside of the condensers and then blow air through them, trying to find a favorite rate of blast, and we found when the temperature outside was up in the nineties, we could keep the temperature in the room down in the seventies, and the inside of the scrubbers was even less than that, due to the vaporization of the water. You could go in that room and find it quite cool in the summer.

XV. A METHOD FOR PREVENTING NAPHTHALINE STOPPAGES BY INJECTING INTO THE GAS HYDRO-CARBON VAPOR.

From W. A. Baehr: We have always found considerable trouble during the fall months from naphthaline. This trouble occurred not so much at the works as it did in the street in the distribution system. We have found the following a very successful plan for getting rid of this trouble. A piece of flanged 16-inch pipe about 10 feet long was fitted with cover plates at each end, and through one end the steam coil was introduced, the exhaust steam passing out at the same end. This coil was set in the bottom of the 16-inch pipe, which was laid horizontally. When using, we partly filled this vaporizer with Pintsch hydro-carbon oil or gasoline. The hydro-carbon oil is better than gasoline. We then closed the stop-cock in the inlet pipe for oil, and turned the steam through the steam coil. This, of course, vaporized the contained oil, and by means of pressure gages, we saw that the pressure did not rise too high. When we had obtained about 20 pounds of vapor pressure, we opened the valves, permitting the vapor mixed with the exhaust steam from the steam coil to enter the street main, during the hour of maximum consumption. By suitable piping we are also enabled to force this vapor into the inlet or outlet of the holder or into the pipe leading to our district holder or into main feed line. When we noticed naphthaline troubles beginning in the fall, we immediately started our vaporizer every evening about five o'clock. One charge lasted about one hour, and the results were always satisfactory.

DISCUSSION.

Mr. Dunbar:—What is the advantage of permitting the vapor to reach 20 pounds before turning it into the main?

Mr. Doherty:—I guess I am the only one that can answer that question, and I guess I cannot, except that I know this is Mr. Baehr's idea, and I suppose if he gets pressure in his tank in that way, the vapor will travel farther without condensation, it will have great volume, and if it is going to condense it will get farther away, and then if there is any congestion in the immediate neighborhood it would act as a bulldozer.

Mr. Littlehales:—Does he let that quantity out very quietly?

Mr. Doherty:—I do not know how he works it.

Mr. Eysenbach:—I think he does. The idea is to get this gasoline vapor to go out with the gas, and 20 pounds insures its being thoroughly vaporized; this is my view of it.

XVI. A SHAKING COKE SCREEN.

W. A. Baehr describes this as follows: The shaking screen consists of two (in this case) screens, inclined about 30 degrees from the horizontal, and one above the other. The top screen is 1-inch square mesh, and the lower one ½-inch square mesh. It is intended in the future to place a third screen above these two of 2-inch square mesh size. The top screen will then catch the coarse coke, the second the nut coke, and the lowest screen the pea coke, while the breeze falls through. The screens being inclined in different directions, cause the coke to roll off into separate piles. All these screens are vibrated to and fro, about 160 times per minute, by a shaft on a crank, which is in turn operated by a system of spur gearing, the final pinion being of steel, machine cut, and direct connected on the shaft of a 3 horse-power electric motor. The motor, switch, speed controller and gearing are in a little wood-house on one side, but the whole is on the same base timbers. We dump a cart load of breeze on to the top screen, and in about 30 seconds this is all screened and sorted.

DISCUSSION.

Mr. Doherty:—I would add, that if anybody is going to make a shaking screen I advise them to make it out of punched metal rather than meshes. Our screens have not worn out in Denver.

We have used them all winter, but I know from experience that a mesh screen wears out much faster than a steel plate punched to the size you want.

MR. STONE:—That is true of every shaking screen and revolving screen. We have a revolving screen at our works made of meshes and it is getting pretty badly worn. I know of another screen placed in works similar to ours, made of punched metal, and I do not believe we have done as much work with ours as they have with theirs, and it is in good shape yet.

MR. DOHERTY:—We adopted the shaking screen in Denver because from the result of observation and experience, I believed that the shaking screen could be constructed more cheaply and would do more work for a given area of screen, and would require less power to operate it, but we made a meshed screen in Denver instead of a punched plate. If we had not been in a hurry about it we would have used a punched plate, and I would advise anybody else to use a punched plate and not a wire screen.

XVII. COMPLAINT BOOK.

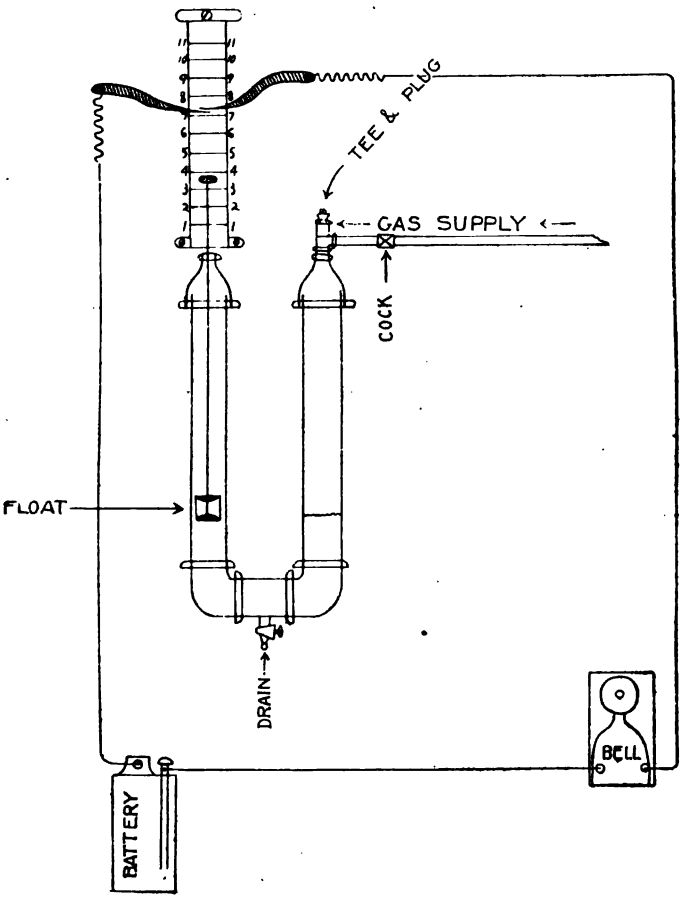
C. S. Ritter sends us the following: A number, say about 25, information slips, copy of which is shown, are bound together in the form of a small book convenient for the vest pocket. These are given to the employes of a company, to be used as a convenient means of noting matters that come to their notice while off duty, and that should be brought to the attention of the company. Some of the things that have been reported in this way are leaks, poor lights, coke scattered on the streets by the company's teamsters, various complaints and orders, etc., all of which should be brought to the company's notice.

Form B 178. 10m. 6-27-00.
DETROIT CITY GAS CO.

INFORMATION SLIP. Date..............190..
Location ....
Name ....
Kind of gas ....
Information ....
....
....
....
Signed ....

XVIII. COMBINATION PRESSURE GAGE AND ALARM FOR INDICATING AN EXTREME BACK PRESSURE.

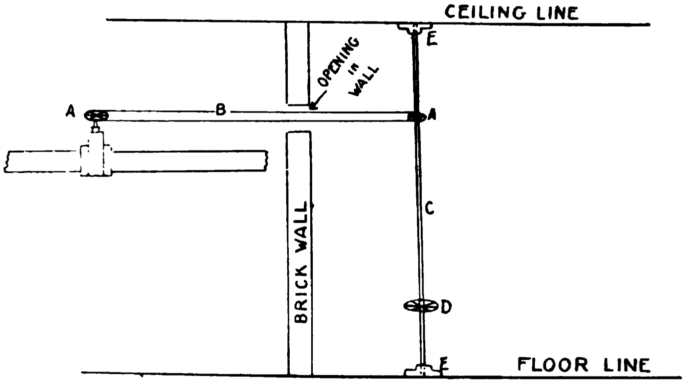
C. A. Schwarm describes this device: Two brass spring electric contacts are placed at a point indicating an abnormal pressure, and when a choke or stoppage occurs in the work's apparatus, the float rises with the liquid in the gage, forces the two contacts together and rings a bell placed in position so as to be heard by the work's foreman or watchman. The device is a cheap pressure gage, and answers every purpose of the ordinary U-siphon gage, and when provided with the electric attachment will instantly make an alarm when the back pressure reaches an abnormal point.



NO. XVIII. AUTOMATIC ALARM GAGE FOR BACK PRESSURE.

XIX. A CONVENIENT ARRANGEMENT.

An arrangement for the convenient handling of a valve that is frequently used and situated out of reach from the operating floor, is shown by C. H. Printz in the accompanying sketch.



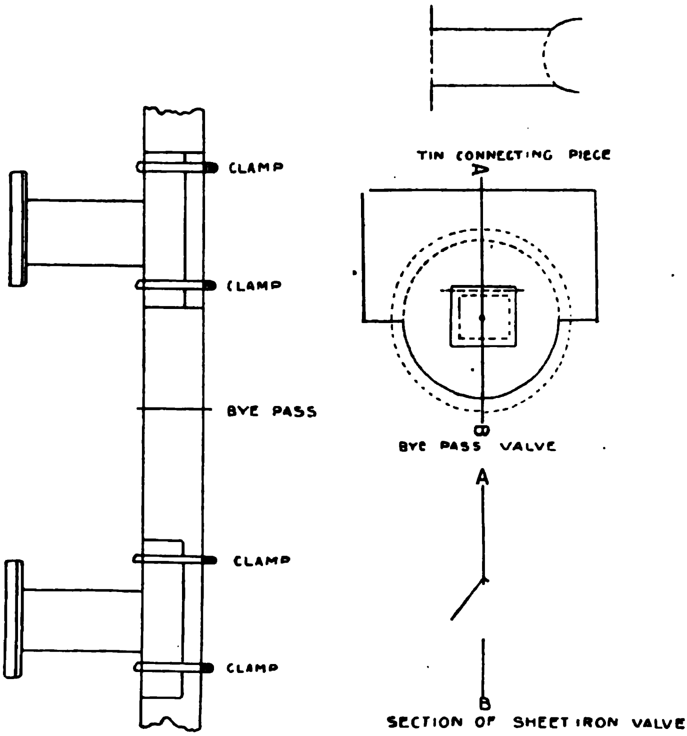
A — COG WHEELS
B — ENDLESS CHAIN
C — 1" ROUND IRON
D — HAND WHEEL
E — BOXES FOR SHAFT C

NO. XIX. OPERATING VALVES OUT OF REACH.

XX. A TEMPORARY CONNECTION WITH EXHAUSTER, MADE WHILE WORKS WERE KEPT RUNNING.

F. W. Stone sends the following: I was in a town the other day where it had become necessary to place an exhauster in position and still keep the works running. The holder had gotten so low that it was impossible to shut down even for the few hours necessary to make connections to the exhauster. More than this, while the exhauster had arrived, the connections for it had not yet arrived, and it was absolutely necessary to have the use of the exhauster at once. The main line going through the works was drilled with a number of holes on its side, the holes coming opposite the inlet and outlet pipes of the exhauster, as shown in the sketch. The pipe was 6 inches, and there were several 1¼-inch holes drilled opposite both the inlet and outlet. Some tin pipes had been made which had one end saddle-shaped so as to be fitted to the 6-inch main pipe and the other end flanged so as to connect to the exhauster. These are attached to the exhauster, the plugs

taken out of the holes which had been drilled in the main pipe, and the exhauster shoved back into position. The saddles on the tin pipe were then securely clamped to the main pipe by means of iron bands. It was now necessary to provide a by-pass valve. This was done in the following manner: Between the inlet and the outlet the main pipe was cut through the upper half of its circumference. A pipe of sheet iron had been provided, having another piece in it swung like a swing check valve. This piece of sheet



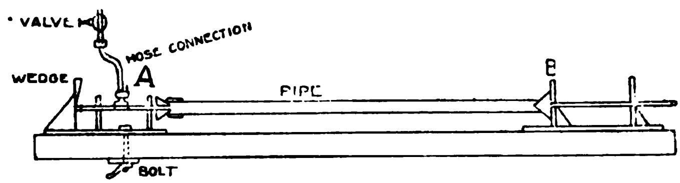
NO. XX. CONNECTING AN EXHAUSTER WITHOUT SHUTTING OFF GAS

iron was cut so as to fit closely to the pipe, and was then inserted down through the opening. The swing, of course, was made so as to open when the gas pushed against it and close when the pressure was the other way. A little soft wax was used to make the sheet iron tight where it projected through the opening in the 6-inch pipe, and an accumulation of tar or pitch on the bottom of

the pipe soon made the lower edge of it tight with the bottom. The exhauster had been running about three months in this condition when I last saw it and was doing first rate work. If the work could not have been done in this manner, the works would have had to shut down.

XXI. HEATING PIPES FOR COATING WITH TAR OR ASPHALT.

F. W. Stone sends description as follows: End of pipe is placed on cone at, B, then carriage, A, is run up till cone enters other end, and fastened with bolt. Wedge is then driven up to

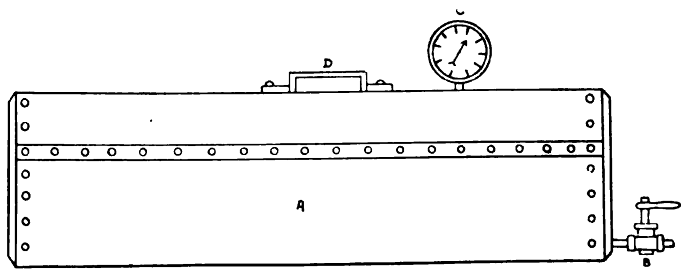


NO. XXI. DEVICE FOR HEATING PIPES WITH STEAM WHEN COATING WITH TAR.

make tight, and then steam is turned on through hose connection. Cones are cast iron, the one at end, A, has hole for passage of steam, both screwed on and supported by pieces of 1¼-inch pipe. Frame made of 2-inch plank.

XXII. PRESSURE TANK FOR INJECTING ALCOHOL IN THAWING SERVICES AND RISERS.

Henry W. Douglas sends the following: Appreciating the desirability of something light and more convenient than the old-style Bell service cleaning pump, I had made of galvanized iron



NO. XXII. PORTABLE PRESSURE TANK FOR ALCOHOL.

a tank 9 inches in diameter and 27 inches long. A nippple was soldered into one side, on which was screwed a small pressure gage, C. On the bottom of one end was put a ½-inch lever handle stop, B. A handle, D, was riveted on the top for convenience in carrying. A small amount of alcohol was put in the tank, and pressure of about 20 pounds pumped up by means of a proving pump, service pump, or even a bicycle pump attached to the stop. The tank is then connected by hose to the service or riser, and with the back end of the tank tipped up the cock is thrown wide open. The alcohol is injected through the pipe in a fine spray. It has been found very convenient where pipes are inaccessible, as the pressure can be put on the tank in a convenient place and then carried to the top of a step-ladder, if necessary, for injection.

On motion, duly seconded and carried, the Association adjourned until Thursday, March 20, 1902, at 10 o'clock A. M.

SECOND DAY.—MORNING SESSION.

The Association met at 9:30 A. M. After calling the meeting to order, the President called for the discussion upon "Distribution of Gas at High Pressure," by F. H. Shelton, of Philadelphia, Pa., which was read by Mr. Tayler, as follows:

DISTRIBUTION OF GAS AT HIGH PRESSURE.

F. H. SHELTON.

Your President has requested from me, as a "short topic" for discussion at this meeting, a statement as to the conditions under which delivering gas at a number of pounds pressure becomes useful, in the way that I inaugurated some two years ago, and with which practice I have recently been rather associated. I am glad to briefly give you the results of some two years operations and conclusions.

The essence of high pressure work (and by that I mean the starting of the gas out at 10, 20 or 30 pounds pressure) is that by such means pipes of but one-half or one-third the usual size can be used, and hence construction cost greatly reduced. Four kinds of situations come to mind in which this way of working enables saving in running expenses, or improvement in service, or the extension of gas supplies to places that otherwise would have to go without.

1. The Supply of Adjoining Works.—As an example: At Phœnixville, Pa., the first line was started December, 1899, running 5½ miles, 3-inch pipe to Royersford and Spring City, enabling the closing down of those works, and making all the gas at Phœnixville. At Rockaway Beach, N. Y., a similar line, 6 miles long, 4-inch size, has enabled the supply and the closing down of the old Far Rockaway works. At Hackensack, N. J., a 6-mile line, 5-inch size, has enabled the closing down of the Rutherford works.

2. The Re-inforcement of Supply to Existing Mains Overtaxed.—New Orleans has over 200 miles of mains. Heavy gas fuel business has overloaded them. An 8-mile independent system of new 6-inch and 4-inch pipe leading to five points in the city, where it ties into the old mains, is now finishing. By these pipes and a gas pump at the works 50,000 to 75,000 feet of gas per hour is switched to the districts where it is needed, at a cost of some $45,000 for the equipment, where 24-inch and 16-inch boosting mains otherwise laid in the old way would have cost $100,000 or more.

3. Extension of Gas Supply to Nearby Points.—If $40,000 or $50,000 is required to build separate plants to supply gas in sundry small towns, many will go without; but if $15,000 to $20,000 will get gas there by high pressure from the nearest gas-works many such towns get gas service that otherwise would not. For example: The River Shore Gas Company, Riverton, N. J., by a 3-inch line, 4 miles long, to Moorestown, and a 3-inch line, 2½ miles long, to Riverside, supplies gas by high pressure, for little cost, from its plant at Riverton to these places of 3,500 to 2,500 population that otherwise would not get it. The North Shore Gas Company supplies gas from its works at Waukegan, Ill., through a high-pressure pipe, 4-inch size, 12 miles long, to the neighboring points of Lake Forest, Fort Sheridan, Highland Park, etc., that would otherwise have waited a long time if a 20-inch main had had to be laid. Several other examples of this condition exist where high pressure has opened up districts otherwise not ripe.

4. Supply of a Thin or Scattered Territory.—The Philadelphia Suburban Gas Company, with its works at Darby and first business through 25 miles of low-pressure main, to a fairly compact district, supplies also, however, an additional population of

10,000 or more in a dozen or more villages and boroughs scattered over a territory 8 miles long and 3 wide, to which it would not have paid to run for five years yet the 16-inch and 12-inch pipes, otherwise necessary on usual lines. High pressure has developed this territory. The largest main is 6 inches; 1¼-inch pipes supply many streets. There are altogether some 25 miles of this high-pressure system, directly supplying 1,000 or 1,200 customers at from 5 to 15 pounds pressure, with individual pressure regulator in each house. A couple of $600 pumps keep up the supply perfectly well. No holders are used.

The above instances clearly show the use and application of high-pressure gas distribution. It is entirely and practically successful. I think each of these dozen places now using it are fully satisfied with the results. One is in its third year. Several are in the second year.

It is no longer a question of experiment, but simply one of cost. A given business exists. A 3-inch, 4-inch or 6-inch high-pressure main will reach it from the works. This main will cost so much. A pumping plant will cost $700 to $2,000. The pressure regulators will cost a few hundred dollars. Allow, say, 2 cents per 1,000 for the running expense of pumping the gas, and you can easily figure whether it is worth while or not.

No holders are needed at the far end. We have not used such for two years at Phœnœixville, nor ever at Darby, nor have half the other places using high pressure. Condensation and break-downs and loss of candle-power, and also the other bugaboos that were thrown at me when I first started this plan of working, will not trouble you. The equipment works just as well as the rest of gas-works machinery. High pressure has come, and come to stay. More plants are going in. It is extremely helpful in many circumstances, and to those of you who want to boost low pressure at little cost, or want to consolidate with a nearby works, or want to get gas to a small place nearby, or, in other words, want to push gas cheaply from the place where it is wanted, I say to you, high pressure is well worth carefully considering.

My ideas more in detail you can find in three papers already read by me. The first at the Western meeting in Milwaukee, "Distributing Gas Under High Pressure," in June, 1899, gives the logic and theory of it. The second, before the New England Association, February, 1900, "Pumping Gas Five Miles at Twenty Pounds Pressure," describes the first, or Phœnixville line. The

third, "The Reduction of the Cost of Distribution by the Use of High Pressure," a paper before the International Gas Congress in Paris, September, 1900, goes more fully into the subject, the details of equipment, etc.

But accept this word of caution: Do not string a pump, a line of pipe, and a regulator only together, and expect satisfaction. There are a score of details necessary for satisfactory results. If the work is badly planned and executed, it will be a source of danger, expense and dissatisfaction. But with the details and small parts properly planned and carried out, gas can be handled safely at 20 pounds pressure, economically and with great satisfaction.

DISCUSSION.

PRESIDENT DOHERTY:—Gentlemen, this is a discussion of a subject where we hoped to have two men in favor of and two against, but three of our expected contributors disappointed us. We will have to look for an impromptu discussion on the floor.

MR. LITTLEHALES:—Mr. President, I think it is clearly evident to us all that Mr. Shelton has in the experiments he has made and in the undertaking he has carried out, conferred a very great and lasting benefit on the gas interests, by demonstrating in the practical way he has that what seemed at first to be such a radical departure, has, with experience, proved to be thoroughly successful. I am a thorough believer myself in the practicability of that method, and it can be applied very advantageously, I am sure, in a great many places by many gas companies supplying outlying districts. I have been figuring this out myself for several places, and I find that it can be very practically and advantageously applied in a number of cases where I have had occasion to figure on the same basis. It has been said that it is futile to accomplish things which are impossible, but this has been done. Now, if a thing has been done for three years all the theories on earth cannot alter that fact. It is fact *vs.* theory. The question which has always worried me is the loss of illuminating power or the possible loss due to condensation, because I know in compressing Pintsch gas a great deal of hydrocarbon originally formed in the gas is squeezed out of it by compression, yet it seems that there is no perceptible difference or no difference that the trained eye can discover. Doubtless there may be some difference which a careful photometric test or a bar photometer would reveal, but

the gas man, whose eye is pretty well trained in judging of the intensity of lights, has been unable to discover any perceptible variation.

MR. DUNBAR:—You indicated in your address yesterday, if I mistake not, Mr. President, that you were not in accord with the efficiency of distributing gas under high pressure. Am I correct?

PRESIDENT DOHERTY:—You are correct to this extent: I qualified that by saying "very high pressure." We have had underground installations running up to about 20 inches for a good many years, and up to that point I consider it thoroughly practicable. I think the conditions are very few where you are warranted in going above 5 pounds.

MR. DUNBAR:—I wish you would give us your reasons for opposing the distribution of gas at very high pressure, and in doing so I would like you to give us the benefit of your ideas as to the relative efficiency of a compressor or exhauster, a rotary exhauster working, say, at .5 pounds pressure.

PRESIDENT DOHERTY then vacated the chair in favor of Vice President Andrews, after which Mr. Doherty said: In 1848, I think, Pole's formula was announced to the gas fraternity and has been in universal use ever since, except for computing the flow of natural gas. The factors in that formula are the pressure, the distance and the diameter of the pipe. From numerous experiments that have been made in this country and in England gas men have never had occasion to believe that Pole's formula was far from correct. They believe that the flow of gas increases as the square root of the 5th power of the diameter, or about as the 2.5 power. They also had no reason to believe that the law that the flow of gas varies as the square root of the pressure was incorrect, or if you wish, you can reverse that law and say that the resistance would be as the square of the gas flowing. Now, say, a 1-inch pipe has a conductivity of 1. If Pole's formula is right then a 2-inch pipe has a conductivity of about ½ times that much, and a 3-inch pipe has a conductivity of about 16 times a 1-inch pipe; and a 4-inch pipe has a conductivity of about 32 times a 1-inch pipe. If you have a 1-inch pipe, and you are running at an ounce pressure (equivalent to about 1.7 water pressure), to increase your flow 5.57 times you have to increase your pressure to about between 25 and 30 ounces, to make a 1-inch pipe equivalent to a 2-inch pipe by pressure. To make a 1-inch pipe equivalent to a 3-inch pipe by pressure would require a pressure which would

be the square of about 16 or 256 ounces. To make it equivalent to a 4-inch pipe, you would have to take the square of 32 or 1,024 ounces to make a 1-inch pipe equal to a 4-inch pipe in conductivity. Now, Mr. Shelton has gone into the use of higher pressure and is getting practical results from it. I have never seen any detailed tests on the results he was getting; I have never seen any accurate measurements to tell whether his candle-power has repreciated or not. I believe it will be depreciated not only by compression but by the velocity of the flow, which induces all the evil effects of impact and resembles the very process we use for taking tar and the heavier vapors out in our manufacturing plants. Now, I do not know that the flow has been increased in any faster ratio than Pole's formula. I have never seen any figures that disproved Pole's formula, and it seems to me that the pressure required is so enormous that if you are going to have any great volume of delivery you can better afford to put in a larger pipe and stick to reasonably lower pressures. Now, another consideration is the great loss resulting from the compression of air or gas. Take this air transmission plant in Michigan, and the efficiency of that plant is about 30 per cent.; the transmission and mechanical deficiency is 10 per cent.; and the other 60 per cent. is thermal loss. As soon as you start to run up the pressure of a gas you are dissipating more or less heat. The reason I asked for a contribution on this subject was with the hope of getting about half a dozen gas engineers here so that they could whip this whole thing out and let the gas men of this Association see how far they were warranted in using high pressure, and what were its limitations. I find an impression in the gas fraternity that high pressure has no limitations. I know that it has some. I also know that high pressure has certain applications where they can advantageously be made. What I wanted to do was to get four or five men here and get them to quarreling over it, and when they got through the members of this Association would know about what the limitations of high pressure were and what the limitations of low pressures were.

Mr. Littlehales:—I would like to supplement my previous remarks by stating that I had more particularly in mind the delivery of gas at long distances, distributing under high pressure, which would be the case in carrying it from central points to surrounding towns or villages. That is my highest appreciation of it rather than the distributing under high pressure at short

distances, because I know it is available for long distances and that is the point wherein I appreciate its great value.

VICE PRESIDENT ANDREWS:—Mr. Shattuck, we would be glad to hear from you on this matter, inasmuch as you are familiar with what is being done at Darby.

MR. SHATTUCK:—Most of the features of our plant have been covered very thoroughly in papers written by Mr. Shelton, so that you probably all know of the work doing there. We are supplying gas under high pressure locally to every consumer; we have a low-pressure system through five towns and a high-pressure system through seven, and we are about to consolidate the two plants and shut down one of them, connecting our low-pressure direct with the high-pressure, so that the entire system outside of one large city will be a high-pressure system. I do not think we would recommend for a minute the taking up of low-pressure mains and putting high pressure in place of them, but for suburban territory where we could not borrow the money to put in a low-pressure system, the only thing we could do was to put in a high-pressure system in our case. We are getting a nice return for the money invested and it is the character of country which I doubt will ever be thickly populated enough to warrant taking up the high-pressure system and installing a low-pressure system. It is largely residential and I think it is the ideal system for that territory. For instance, we are running a line of 1¾-inch pipe and we have 25 to 40 consumers per mile. We can do a nice business on the investment by the high-pressure system, whereas with a low-pressure system we would want a great many more than that. We are experimenting in pumping gas by putting in more economical engines, using duplex compressors and cutting the steam consumption anywhere from 70 to 80 pounds per horse-power down to less than 30, and by compounding we can do even better than that, cutting it down, perhaps, to 20 pounds. That makes the pumping per 1,000 feet very cheap, less than one cent; just how much cheaper than that I cannot state without further experiments, but we will be in shape before very long to tell accurately just what it costs to pump gas at high pressure. The candle-power does not seem to be affected by compression, that is, commercially. It has not been tested with a bar photometer, but with an ordinary jet photometer—rigged up, the high pressure and the low pressure to the same jet photometer, the high-pressure gas

showing about one candle-power more than the low-pressure. The reason of that, I suppose, is because of the condensation from compression, which seems to change its specific gravity, dropping out the moisture and making it lighter, but commercially you may say that there is no loss in candle-power.

H. A. CARPENTER:—Has there been anything said about the amount of gas that anyone of these small lines is delivering under a given pressure? The velocity of flow is the troublesome point I should think, and I have not seen any figures given in any of these papers touching on that point.

MR. SHATTUCK:—We find in the crude experiments we have made that we are getting about 25 per cent. more delivery than the theoretical formula, as far as we have been able to ascertain so far. I made an attempt only recently, after measuring the actual discharge of 1¼-inch pipe through 2,400 feet, and with the consumer burning the gas 10 feet per minute through a 2,400-foot pipe of 1¼ inch I found that the pressure in the line fell so slowly that practically the record was not of much value. For instance, we were not pumping at the time and the pressure on the main line was 18 pounds and at the end of this service it stood at 18½, so that the pressure was going down very slowly on the main line, but falling less slowly on the service from which they were burning the 10 feet a minute, but as I said before,we find about 25 per cent. more delivery from the crude experiments we have made than the theotretical formula would indicate.

MR. DOHERTY:—In other words, Mr. Shattuck finds that the flow of the gas is as the square root of the pressure—that that law is not accurate for high pressure.

MR. SHATTUCK:—Not accurate for high-pressure gas distribution.

MR. DOHERTY:—How do you explain that fact?

MR. SHATTUCK:—I am at a loss to explain it. Whether that law is working out specific gravity I cannot say. It is an air law, I think. I do not think it is true for all gases at high pressure.

MR. DOHERTY:—Mr. President, the law that the flow of gas is as the square root of the pressure, and taking the drop of pressure through the pipe as the pressure factor, I know, is not strictly correct. The flow is greater than that. Now I never wanted to appear as trying to help the advocates of high pressure out in the

way of explanations for the upsetting of our old formulas and laws. I know that Pole's formula does not apply to high pressure, and I cannot see but that all energy put into the gas in compressing it results in adding that much to its conductivity. There is nothing else to come from pressure because you pick up the necessary temperature in the ground and it virtually stays at a constant temperature and that energy is stored up in the gas and it must dissipate itself some place and does so in increased conductivity. That is a nice little problem in thermodynamics that I do not care to tackle. But, still I do not think there is a great deal in high-pressure systems.

MR. MOSES:—We are making preparations to put in about 39 or 40 miles of high-pressure pipe and will start on it in about two weeks. It will run from 20 to 30 pounds. We expect to deliver 150,000 feet an hour at 38 miles and do it with a 12-inch pipe. The 12-inch pipe is rated at about 185,000 feet capacity.

MR. DUNBAR:—I asked as to the relative efficiency of compressors or exhausters working, say at 5 or 10 pounds pressure. I wish some one who can would give me information on that subject.

E. D. JOHNSON:—There have been no very accurate tests made between compressors and high-pressure exhausters, but from the practical results obtained by those who are using them I will say that they prefer the exhauster on account of the first cost largely. In one instance, I remember where the test was made with air—not with gas—and the effieciency of the exhauster from three to seven and one-half pounds, was a higher, mechanical efficiency as well as volumetric, than the air compressor. Beyond seven and one-half pounds I guess the ordinary compressor will have the advantage, but below that with the water backing for the rotary machine we get a higher efficiency than the air compressor, and with air I presume it would be the same as with gas.

MR. SHATTUCK:—An ideal compressor to my mind is one that has mechanically actuated inlet valves measuring a full cylinder at each stroke. These valves are operated practically like the Corliss valves. We have an engine of that kind at present and the slip in the machine must be very little indeed.

MR. CARPENTER:—I think that it might be a good plan for this Association, perhaps, to appoint some one of the gas companies

or engineers of gas companies interested in this subject to make experiments on the delivery of artificial gas through various lengths of different sized pipes at varying pressure so as to settle this question. If Pole's formula is wrong and no one can come forward to substitute one that is correct, why I should think it would be to our advantage to settle this matter by experiment as soon as convenient.

MR. DOHERTY:—I think it would be rather a hard thing for this Association to get anbody to take up an experiment of that sort. I have thought about it and have given it a great deal of consideration. It cannot be done without a great deal of work and a great deal of expense, but what I think the Association could do would be to appoint a committee to prescribe how such a test might be made—that is the stumbling block—to get some accurate data. I simply suggest this to Mr. Carpenter, and then he can formulate his motion accordingly. I would suggest that he word it so that it would authorize the appointment of a committee to prescribe methods for determining the law governing the flow of gases at all pressure, then any gas company can take it up very easily.

MR. CARPENTER:—I did not intend to make a motion, but simply a suggestion.

J. O. JOHNSTON:—Perhaps, if you are about to appoint a committee, I might suggest how they could obtain some little information at least. Natural-gas companies have had a large experience in piping gas under varying pressures, and from such experience are fully convinced that the formulas from which tables are constructed are not accurate; and, in my opinion, accurate figures can only be arrived at when the changed conditions of velocity and friction are taken into consideration. I believe that the engineers of natural-gas companies controlled by the Standard Oil Company have made some thorough tests in this direction, and undoubtedly valuable information could be secured from them. My own experience in the measurement of gas under varying pressure has been by the use of the Pitot gage, together with the formulas and tables prepared by Professor Robinson, which under moderate pressures are fairly accurate, as shown by the meter measurement of the same gas. However, I find that where there is an increase of pressure that there is an increase in the meter measurement of the gas over and above the amount shown as

measured by the Pitot gage. I believe the reason for this discrepancy is due to the fact that existing formulas do not take into consideration the changed conditions of friction and velocity. My idea is that by an increase of pressure you have a much greater increase of velocity in the center of the pipe without a corresponding increase of resistance, and that if accurate data could be secured it would be found that from 5 to 50 per cent. more gas would pass through a line with increased pressures than the amount figured from existing formulas and tables.

COMMITTEE ON FLOW OF GAS UNDER PRESSURE.

VICE PRESIDENT ANDREWS:—I am sure the opinion Mr. Johnston has just given us is very valuable as indicating what is being done along similar lines in natural gas and if Mr. Carpenter will make a motion covering the point brought up a few moments ago I shall be glad to put it to the Association.

MR. CARPENTER:—I move you, Mr. Chairman, that the President appoint a committee to investigate the subject of the law governing the flow of artificial gas at high pressure or at pressures above the ordinary.

MR. LITTLEHALES:—I second the motion. I presume that would include the President's suggestion of ascertaining the best practical mode of carrying it out?

MR. CARPENTER:—Of course, my motion is intended to comprehend the appointment of a committee to cover the subject as fully as it can in whatever direction seems advisable, and to report at some future time.

The above motion, being duly seconded, was then unanimously adopted.

PRESIDENT DOHERTY, resuming the chair, said: Has anybody anything to add on this subject? I will appoint on that committee Messrs. H. A. Carpenter, Pittsburgh, Pa.; J. O. Johnston, Columbus, O., and J. D. Shattuck, Darby, Pa. And I will request that that committee, if it cannot determine by experiment these disputed points, will report as soon as possible on the best method of making such a test, so that any one without the technical knowledge can undertake the test if desired. We will now take up the discussion of the subject, "Recent Developments in By-Product Coke Ovens," by Dr. F. Schniewind, Thomas Littlehales and C.

W. Andrews. Dr. Schniewind is with us, and I will ask him to read his contribution on this subject.

Dr. F. Schniewind, of New York City, then read on the above subject the following written discussion:

RECENT DEVELOPMENTS IN BY-PRODUCT COKE OVENS.

DR. F. SCHNIEWIND.

The coke oven has, of late, attracted the serious attention of the gas engineer. "Coke-oven gas" has been recovered in by-product coke ovens for many years, especially on the European continent. The United States and England were slow in changing from the beehive oven to the modern type, but recently the introduction of by-product coke ovens into the United States has made very satisfactory progress.

There are in all, in operation and in course of construction in the United States and Canada, about 3,000 by-product coke ovens. By far the larger number of these plants has been built by, or according to plans furnished by the United Coke and Gas Company. The list of ovens in operation and in course of construction is as follows:

BY-PRODUCT COKE OVENS IN COURSE OF CONSTRUCTION, BY THE UNITED COKE AND GAS COMPANY.

No.	Owner.	Location.	Erected	Ovens	Coke used for	Gas used for
1	Cambria Steel Co..............	Johnstown, Pa......	1895-98	160	Blast furnace	Fuel
2	Pittsburgh Gas and Coke Co....	Glassport, Pa........	1896	120	Blast furnace and domestic.	Fuel
3	New England Gas and Coke Co..	Everett, Mass.......	1898	400	Domestic and locomotives...	Illuminating
4	Dominion Iron and Steel Co.....	Sydney, B. C........	1900	400	Blast furnace	Fuel
5	Hamilton-Otto Coke Co.........	Hamilton, O........	1900	50	Foundry and domestic	Illuminating
6	Lackawanna Iron and Steel Co..	Lebannon, Pa.......	1901-02	232	Blast furnace	Fuel
7	Lackawanna Iron and Steel Co..	Buffalo, N. Y........	1901-02	564	Blast furnace	Fuel
8	So. Jersey Gas, Elec. & Trac. Co..	Camden, N. J.......	1901-02	100	Foundry and domestic	Illuminating
9	Maryland Steel Co............	Sparrow's Pt., Md...	1901-02	200	Blast furnace	Ill'm'g & fuel
10	Michigan Alkali Co...........	Wyandotte, Mich....	1901-02	15	Burning lime	Fuel
11	Sharon Coke Co...............	Sharon, Pa.........	1901-02	212	Blast furnace	Fuel
		Total	....	2,453		

The latter plants have a daily charging capacity of 8 net tons of coal per oven per day, while the earlier plants vary between 5 and 6 net tons. The entire charging capacity of all these plants is about 14,350 net tons of coal per day.

It is unnecessary to give a detailed description of the process here, which may be found in a paper recently read before the International Engineering Congress at Glasgow. In order to give an idea of the construction of the ovens, a large picture of the Camden (N. J.) plant, now in the course of construction, may be referred to, which is exhibited here. It shows the detailed construction of the ovens proper. Another picture of our new type of ovens, as described in the Glasgow paper, is being prepared. The United Coke and Gas Company will be glad to furnish copies of these pictures, as well as the copies of the paper referred to above. The plant at Hamilton, O., is very similar to the Camden plant, the only exception is that the coke wharf has an angle of about 33 degrees, while the coke wharf of the Camden plant is almost level.

It is the desire to discuss the subject especially from a point of view which will interest the members of the Ohio Gas Light Association, and consequently the process will be described only in a general way.

The retort coke-oven process in its principles is closely allied to the coal-gas retort process. Instead of charging, however, into the retort only a few hundred pounds of high grade gas coal, the retort coke-oven receives a charge of 16,000 pounds of coking slack coal. If no slack coal is available the coal is crushed before charging it into the retorts.

Products.—On average coking coals the following yields are obtained; 75 per cent. coke, of which, for instance, at Hamilton, O., 90 to 95 per cent. is foundry grade, 5 to 6 per cent. tar, 1 to 1.25 per cent. sulphate of ammonia, which is shipped either in the form of sulphate, or in the form of concentrated liquor, and 4,000 to 5,000 cubic feet of surplus gas per net ton of 18 to 20 candle-power, and approximately 700 B. T. U. per cubic foot.

The old-fashioned gas retorts are heated by a part of the coke, while the by-product coke oven is heated by a part of the gas. The coke-oven gas has only become important for illuminating purposes, since it has been fractionally separated. It has been shown that the gas driven off in the earlier part of the coking process, while the temperature of the coal charge is still low, is of a very much higher illuminating and fuel value than the later product.

In our modern ovens the second or poorer fraction is burned under the ovens in order to produce the heat necessary for the coking process, while the first or richer fraction is distributed as an illuminating gas.

The coke can be used either for metallurgical purposes (blast furnaces, foundries, etc.), or for boiler firing, domestic purposes, etc.

Metallurgical Coke.—The consumption of metallurgical coke in Ohio is very large; it is second only to that of Pennsylvania.

No accurate statistics are available for the amount of coke used by foundries and for miscellaneous metallurgical purposes. The production of the Ohio blast furnaces, according to latest statistics, is as follows:

Production of pig iron in Ohio in 1901 by districts:

Mahoning Valley	1,404,857
Hocking Valley	35,000
Lake Counties	783,490
Hanging Rock	299,301
Miscellaneous	793,710
Total, long tons	3,316,358

Each gross ton of pig iron requires nearly one net ton of coke. This tremendous amount of 3,300,000 net tons of coke has been entirely made in beehive ovens, with the exception of the comparatively insignificant output of the 50 Otto-Hoffmann ovens at Hamilton, O.

The production of 1 net ton coke in beehive ovens requires 1½ net tons of average coking coal, but in by-product ovens only 1⅓ net tons are required. The coal consumption for the production of the above 3,300,000 net tons beehive coke has therefore, been 4,950,000 net tons, while in by-product ovens it would have been only 4,400,000 net tons, a waste on coal account alone of 550,000 net tons.

As stated above average coking coals yield in our by-product coke ovens at least 5 per cent. tar, 1 per cent. sulphate of ammonia, and per net ton of coal at least 4,000 cubic feet of surplus gas. If the 3,300,000 net tons coke would be produced in by-product ovens the following enormous quantities of gas, tar and ammonia would be saved every year:

220,000 net tons—880,000 barrels tar.
44,000 net tons sulphate of ammonia.
17,600,000,000 cubic feet illuminating gas.

In addition to this, as stated above, 550,000 net tons of coal less would have been consumed.

It is not probable that such outrageous waste is likely to continue.

Almost the entire blast furnace coke (3,300,000 net tons) and in addition to this several hundred thousand tons of foundry coke have been brought into Ohio from other states, chiefly from the Connellsville district, Pa. The Ohio production of coke has been less than 100,000 net tons per year, which figure has recently been slightly increased by the product of the 50 Otto-Hoffmann ovens at Hamilton.

Since the introduction of by-product coke ovens other coal fields outside of the Connellsville district have been made available for the manufacture of metallurgical coke. These coals did not produce in beehive ovens a coke suitable for blast furnace use. It is far more economical to transport the coal from the mines to the blast furnaces and convert it there into coke in by-product ovens instead of coking the coal in beehive ovens at the coal mines, and shipping it long distances to the furnaces. The freight on a ton of coke is higher than the freight on the amount of coal required for its production. The reason for this is that the coal can be transported and handled much more econmically than coke. Furthermore, coke breaks up considerably during transportation and when handled repeatedly.

The smoke nuisance and the great area required by beehive ovens made the erection of these ovens at the point of coke consumption impracticable. With the by-product coke ovens this is different; there is no objection to the erection of these plants in or near cities, consequently, it is reasonable to expect that the manufacture of metallurgical coke will be moved from the remote coke districts to the iron-manufacturing centers, and hence many of the Ohio cities may expect to see by-product coke ovens and coke-oven gas at their doors.

Domestic Coke.—It is not necessary to discuss the question of domestic coke, as you are so familiar with this subject. The results which are obtained especially at Everett, Mass., in regard to the disposal of the large output has been surprising to all of us. There is a crying demand in all large cities which are situated in or near bituminous coal districts, for a smokeless fuel, and on account of the high price of anthracite we have no doubt that the coke is destined to take the place of the more expensive anthracite,

and of the unclean bituminous coal for all domestic purposes, in office buildings, etc.

It should be borne in mind that the coke is of a very much superior quality as compared with the ordinary gas-house coke, and that it is successfully used for many purposes where gas-house coke has met with no success.

The prices of tar and ammonia have kept up very well, notwithstanding the large output of these by-products which is now being produced by the various plants in operation. Most of the products of these plants have been sold on long-time contracts.

Gas.—The quality of the gas has already been mentioned above. A net ton of average coking coal, giving about 9,000 cubic feet of gas, gives on an average 4,000 cubic feet of surplus gas. If the first fraction of the gas is collected separately these 4,000 cubic feet have about 18 or 19 candle-power without any enriching. The 5,000 cubic feet of poor gas used for heating the ovens still have about 8 to 9 candle-power. This candle-power is almost entirely due to benzol vapors, which can readily be extracted, consequently, the candle-power of the rich gas may be still further increased by adding this benzol. Of course there is a limit in regard to the candle-power of the gas, because coal-gas of higher candle-power becomes smoky, but we have found from actual experience that at Everett, a 20-candle-power coke-oven gas does not produce objectionable smoke. For further information the above-mentioned paper may be referred to again.

Conclusion.—You have honored me by asking me to start a discussion of this very interesting subject. It is impossible to exhaust this subject within a short paper, and I have consequently refrained from all technical details. It is my purpose only to call attention to the importance of this subject, especially in your district. I have endeavored to show that the by-product coke ovens are bound to come, both for the supply of coke to the Ohio blast furnaces and for the supply of smokeless fuel to cities. The by-product coke ovens have for many years been in operation and remunerative as coke producers only even when the gas was wasted. This waste of the gas, however, has now been overcome because the quality has been brought up to such a degree that even the best coal-gas manufactured by the old retort process cannot be compared with it.

As the erection of these plants in your district is bound to come, will the gas be wasted?

THOMAS LITTLEHALES, of Syracuse, N. Y., then read his written discussion on this subject, as follows:

BY-PRODUCT COKE OVENS.

THOMAS LITTLEHALES.

When your Secretary sent me an urgent request to say something on the subject of "Recent Developments in By-product Coke Ovens," it did not appear to me that I could say much more than I had said in the paper I had the honor of presenting at the Boston meeting of the American Gas Light Association, in October last, and it was only in the hope that the re-opening of the subject here might lead to a discussion in which other members of the Gas Fraternity may be induced to express their views pro and con, and throw more light on the question, that I appear before you.

The incessant and imperious demands which the multifarious daily duties of a gas manager impose, prevent him giving to new subjects that lengthy and continuous investigation necessary to get at all the facts; much has to be taken on trust; and often when experiments are made without sufficient knowledge beforehand of all the factors involved, they lead to costly and often disheartening experiences; nevertheless, we are indebted to the men who attempt them, because so much may be learned even by a failure; and there are but few, of even the most successful undertakings, that have not had a share of these costly and disheartening experiences in their early stages; but as "hope springs eternal in the human breast," especially when that breast is supported by the backbone of the average gas man, he is not easily downed or disheartened, although there is a streak of conservatism in most of us that leads us generally to prefer following well-trodden paths, rather than risk stubbing our toes against obstacles that may be obscured in untrodden ones.

An unusual opportunity having occurred to me for giving continued study, investigation and observations of retort-oven working results, advantage was taken of it, and the results and conclusions so reached are before my gas brethren in the paper referred to.

Before commencing investigating the retort ovens, there was a pretty strong conviction in my own mind, that as gas producers the ovens were simply not in it with retorts; and if that were all there was to the question, viz., ovens as gas producers, the same

position might probably be maintained to-day; but that is not by any means the case; other factors than gas production have so important a bearing upon the question, that one can safely use the old aphorism about "circumstances altering cases." And it may not be out of place to indicate to you the facts that changed my former views on the ovens as compared with gas retorts.

On looking into the retort oven working for the first time, the first thing that will probably strike a gas man, will be the fact that from the time the coal reaches the siding in the cars, until the coke is quenched, every part of the coal and coke handling is done by machinery, except the pulling of the levers to open and close the valves letting the coal into the charging larries and again from these larries into the ovens. As he watches the filling of three larries, each containing a little over 2 tons, in a total of about 3 minutes, sees them emptied into the ovens almost as quickly, and when the charge is burned off, sees the whole of the coke from say 6½ tons of coal, pushed out and quenched in about 2½ to 3 minutes, and the oven doors then closed up again ready to be re-charged, in 4 or 5 minutes, he will begin to realize that the ideal of all progressive gas men, to substitute machinery for the arduous labor of stoking, is about reached; and mind you, the simplicity of operations being such as to enable any ordinary laborer, without previous training or experience, to perform them satisfactorily; it will soon begin to appeal very strongly to his common sense and judgment to say nothing as to his ideas as a manager, as to its probable effect on the balance sheet at the end of the year. It seems to me to be so plain and self-evident that the proverbial "blind man on the galloping horse" could almost see it.

The questions will then arise about the relative areas of ground occupied; the relative cost of construction to gas made as compared with the retorts, the fuel account, the wear and tear charges, as compared to retort methods; and then when all things are taken into account, losses and gains considered, by which method can most money be made, and under what conditions can the ovens be advantageously operated.

According to my figuring, when the whole thing was summed up, the advantage was largely on the side of the ovens; in short, that given an outlet for coke, the oven operators could, at a fair profit, put gas into the holders of a gas company at a price sufficiently lower than a gas company can make it, as to have an important influence on the profits of a gas company, or in reduction of the price of gas to the consumer.

There does not appear to be any new facts or figures of importance to present to you, other than those given in my paper at Boston, and as that paper has been printed in *The American Gas Light Journal,* November 25, and *Progressive Age,* December 16, it is assumed they have been before you, or that you can readily refer thereto, so your time will not be taken up in going over them again, further than to give a resume of the facts, but the subject will be dealt with now, more as a continuation of that discussion.

The paper showed from one United States Government report, that the coal used annually in the United States for coke making, was upwards of 30,000,000 of net tons, which was 14 times a greater quantity of coal than is used in 433 cities and towns in coal-gas making and that the coke made therefrom in coke ovens amounted to about 20,000,000 of net tons; and that assuming the recovery of 4,000 feet of gas per net ton of coal, at present wasted, it amounted to 120,877,372,000 feet, more than sufficient to furnish twice over all the gas at present consumed in the 40 largest cities in the United States, allowing a consumption of 4,200 feet per capita of population, and that this was not overestimated; it was shown from another United States Government report that the consumption in 433 various sized cities and towns in the United States gave a total of coal-gas, oil-gas and water-gas made, of 50,385,000,000 feet, while the waste on the basis before indicated, was 120,877,000,000; so the waste would more than supply the 433 cities and towns twice over; and that the further annual increase in coke making involved an annual increase in the gas wasted, nearly sufficient to supply the output of 25 of the largest gas companies in Massachusetts, with an actual average consumption of 2,240 feet per capita per annum, and it appeared as though the question resolved itself more largely into one of the decentralization of coke manufacture than anything else, and of carbonizing the coal at the points where the waste gas and other products could be marketed.

You know that an engineer in laying out a new plant for any purpose is supposed to take all the conditions and peculiarities of that special situation into account, so as best to adapt things to the requirements of that particular case, to enable him to obtain the largest returns from the capital invested, so as soon as sufficient acquaintance with retort-oven working and results had been obtained I started to work in this wise: Assuming a large

city at a distance, of which all the gas-making data, cost of materials, labor, coal, etc., was available, and assuming that an extension of plant of a capacity of 2,000,000 feet per day had to be provided; also, that a knowledge of what retort ovens could do, was desired. On this assumed basis, careful estimates were prepared of a coal-gas plant for 2,000,000 feet per day, and given a certain price at which gas had to be put in holders, figuring out what return should be obtained on the investment on the ordinary retort plan. The same course was pursued with the retort-oven equipment, figuring everything out on similar or properly corresponding basis. The result showed that under the conditions of that place gas from the ovens could be put in the holders with a profit at a price which would mean an absolute loss on gas-retort methods. The make was then cut in two and figured out again on 1,000,000 feet per day, and the ovens still had the advantage as distinctly as before. Again and again, the capacity was cut in two, and also figured on each sized plant, and with different costs of coal, and in every case given the disposal of the coke, the ovens were ahead. The data and calculations were submitted to those abundantly able to criticise them, and the soundness of my position and the correctness of my figures were admitted. The subject has been looked into from every standpoint I could think of, and there is always one condition that will enable a good retort-oven system to be operated successfully in very many places, viz.: disposal of coke; and seeing that retort-oven coke has been abundantly demonstrated to be fully equal to that from beehive ovens for metallurgical requirements, that goes a long way towards securing the necessary disposal of coke.

The fact should be borne in mind that in Germany (and there is no country where science is more thoroughly applied in manufacturing operation than in Germany) by-product ovens have literally driven beehive ovens out of the field.

As an instance to show how metallurgical coke users regard the quality of retort-oven product as compared with that from beehive ovens, the following incident will show: On a recent occasion a certain firm requiring accommodation of a few cars of foundry coke, appealed to another large firm using both beehive and retort-oven coke, to help them out. The answer came that they would let them have beehive, but could not spare any from the retort ovens, which they preferred for their own use.

The main question, then, of the successful and profitable operation of retort ovens, is the disposal of the coke at a fairly moderate price. Given that, all other difficulties can be overcome. The remarkable experience of one gas company in this state is well worth bringing to your notice, where, notwithstanding that soft coal is cheap, the gas company, by wise policy and able management, has so developed the coke trade that not only does it find a ready market for all it produces at satisfactory prices, but purchases large quantities from other gas companies and from coke ovens to supply the demand, and what can be done in one place can surely be done in others if the same wise policy is pursued.

Many gas men who have seen retort ovens in operation when the gas was not being marketed, and noticing the comparatively low illuminating power produced under those conditions, often not more than equal to 8 or 10 candles, have gone away with the impression that that was the normal condition and quality of gas from retort ovens, whereas, it was only the conditions then prevailing, which could readily be changed if requirements called for so doing, because, under the then conditions, the gas was of but small consideration. As a matter of fact, gas of just as good quality and illuminating power can, by proper manipulation and working, be as easily obtained from retort ovens as from gas retorts, and by the separation of the gases, using the riched for illuminating and the poorer for heating the ovens, a considerably higher illuminating power can be obtained from the ovens than is generally obtained in gas-retort operations. This fact was discovered years ago, and has since been put into practical operation. Analyses of the gases produced by the Paris, English and New York Gas Companies, and of those from retort ovens, show that they are all practically of the same general character in every respect.

It has been the custom to build retort ovens in the open air, without any covering to protect them or the men operating them, from the weather. Gas men generally will be disposed to doubt the wisdom of this practice, and the strongest excuses I can see for it are the saving in first cost, and that it was the custom to build beehive ovens in this manner and retort-oven constructors were content to follow suit. If it were thought better on the whole to have a roof over them, there is nothing in the way of its being done except the expense; and probably the interest on the extra cost of the roof would be made up by the saving of fuel in the winter time, and by saving in general wear and tear, to

say nothing of the protection to the men during stormy weather. Few gas men would think of running their retort houses for a single winter season without a roof.

While I do not for a moment wish to withdraw from the position previously taken, that the retort oven is to play a very important part in the gas manufacturing industry in the future, I am inclined to think it will be safer and better for gas companies and oven operators to work together on some equitable basis of co-operation to their mutual advantage, rather than for gas companies in the present stage, to assume risks and responsibilities with which they are not yet familiar. Experience, which in many cases has been costly, is worth money, and often much more than money.

Where conditions exist for such co-operation as suggested, gas can be put into holders cheaper than the gas companies can make it; often enough cheaper to make an increase of from 2 to 3 per cent. per annum on a fair capitalization.

C. W. Andrews, of Hamilton, O., then read his contribution on the same subject, as follows:

BY-PRODUCT COKE OVENS.

C. W. ANDREWS.

Your program committee has requested me to write a short paper as a continuance of the subject of coke-oven gas, already opened by Dr. Schneiwind, and I feel that the most interesting way to present this matter to this Association would be to give you a sketch of the results we are obtaining at Hamilton.

In 1900 we were confronted with the necessity of rebuilding our old plant, as we had outgrown its carbonizing capacity.

As the maximum combined output of the city is at this time nearly 500,000 daily, we decided that it would be a better policy to build a large plant on the latest lines, of sufficient capacity to take care of the total send-out, and also the probable increase of a number of years.

After due investigation of the Otto-Hoffmann system, as installed by the United Coke and Gas Company, it was adopted as being the best system for the conditions surrounding our location.

As you probably are aware the Hamilton-Otto Coke Company started the erection of their 50-oven plant in July, 1900, and the first charges of coke were pushed the latter part of April, 1901,

the plant, therefore, taking 10 months to erect and put in operation. This was considered fairly good time, considering the state of the market.

In course of a couple of weeks of operation we were able to begin the supply of gas to the Hamilton Gas Light and Coke Company, which company had already made a contract for its supply with the coke company.

We found that the candle-power was subject entirely to our wishes, as we were able to maintain any desired candle-power up to 19 without any difficulty, and the calorific value of the gas, above that produced by the retort process formerly used, was very quickly demonstrated, as expressions of satisfaction were constantly received from our patrons, and had not a long and severe strike of the machinists interfered we should have put out a very large number of gas stoves in addition to those we did in our regular course of business.

During the first few months of operation we made a very large percentage of domestic coke, for which a market has easily been found, not only in this vicinity, but also throughout the West and Northwest.

The foundry trade, which we expect to make our main business, was, of course, gradually worked up until at the present writing we have all the orders necessary to operate the plant on practically foundry coke; the amount of domestic coke now being made not being sufficient to supply our local demand.

The gas produced at the coke company's plant is conveyed by a three-mile 8-inch pipe line to the old works of the gas company, where it is purified in the usual way and forced into their storage holders.

In this connection it might be interesting to know that we are using high pressure exhausters for this service, which enables us to force gas at the pressure of 8 feet of water if desirable. This, of course, removes most of the difficulties ordinarily contended with on low-pressure lines of this kind, as condensation or deposits of naphthaline can be forced out of any ordinary traps and carried forward to the drip pots.

As this is a new proposition in this part of the country you will no doubt be interested to know what were the reasons which induced us to go into this new method of manufacturing gas.

Hamilton, as you probably know, has two gas companies, one operated by the Hamilton Gas Light and Coke Company, and one

by the city of Hamilton, each having in conjunction an electric plant, so that either company is prepared to supply either gas or electric lighting, as desired.

The Hamilton Gas Light and Coke Company, however, are operating quite a large power circuit in addition, they having over 400 horse-power in motors.

Their station contains a gas engine of 150 horse-power, which is used in connection with a steam plant for this service, as we consider it advantageous to use the gas in a large engine of this kind.

The city of Hamilton put its gas plant in operation in 1889, at that time reducing the price of gas to $1. This was met by our company making the price 95 cents, although the combined output at that time was only about 20,000,000 annually. From that time until 1895 the price remained at the figures quoted.

In the latter year that price was again reduced by the city to 80 cents net, which price was met by our company without any further reduction, and this price still remains in force.

As a result of these low prices the output of gas has increased amazingly, and with every indication of a continuous growth.

Since the erection of our plant the South Jersey Gas, Electric and Traction Company has started the erection of a 100-oven plant at Camden, N. J., which will be in operation early this summer, and will supply gas to a large number of New Jersey cities.

The Maryland Steel Company is also erecting a plant of 200 ovens at Sparrow's Point, near Baltimore. The surplus gas from this plant will also be used for illuminating purposes.

There are, therefore, four plants either in operation or under construction for the purpose of furnishing coke-oven illuminating gas.

DISCUSSION.

MR. CARPENTER:—Mr. Littlehales makes the statement in his paper that a coke-oven plant, producing 2,000,000 cubic feet of gas in 24 hours, can put gas into the holder at a price that a modern retort plant would work at a loss. I would like to ask Mr. Littlehales the cost of labor employed in that plant—that is, in the retort plant—and at what price he figured the gas-coke.

MR. LITTLEHALES:—In answer to Mr. Carpenter's inquiry, Mr. President, I will state that I estimated the operation of a plant in a certain city of which I had personal knowledge of all

the conditions. Taking the coal at the same price and the labor at the same price, selling the coke at the same price, and assuming a contract to put the gas into the holders at a certain price, a substantial profit could be made on the oven plant where it would be an absolute loss in the retort plant. Now have I made myself clear? I am not prepared to state all of the figures involved, but I will state generally that every factor was taken on the same basis —the cost of labor, the cost of material and selling price.

MR. CARPENTER:—Then, as I understand it, you were figuring the modern coke-oven plant as against the existing gas plant.

MR. LITTLEHALES:—I was.

MR. CARPENTER:—And not against the modern gas plant?

MR. LITTLEHALES:—I beg your pardon. It was as well-equipped gas plant as there is on this continent; second to none.

MR. CARPENTER:—Had it a corresponding amount of machinery for handling coal and for charging coal into the retorts?

MR. LITTLEHALES:—Yes, sir; only I wish to say about the coal-handling question that it is a double-edged sword. A coal-handling plant, in my judgment, in a gas-works is an expensive luxury except for a very large company. There are a great many places where it would not pay. I had occasion to make estimates for an installation of that kind where our coal was all taken in during a very short time, probably within three months, and while we could have handled it at a smaller rate per ton during that time, yet we have to pay interest and deterioration on machinery for the nine months when it was not working. Now there are a great many points where machinery can be used very advantageously if it can be kept working 365 days in the year. It would very much reduce the cost of hand labor, but where it can only be used for a short time, hand labor, I think, is far more economical.

MR. CARPENTER:—I did not intend to ask Mr. Littlehales the cost of making the gas in his coke oven. But for obvious reasons, I think it would be very interesting for him to tell us at what he calculated the labor in that ordinary gas plant and at what figure per ton of coal carbonized or per 1,000 cubic feet of gas.

MR. LITTLEHALES:—The best answer to that, Mr. President, is that I took the company's balance sheet per year for actual expenditures for labor. It was a company I know to be well and economically managed. I took their balance sheet and considered every factor in it, so I know the bottom facts of that company's

working, and I also assumed a contract to put the gas into the holders at a low price, very much lower than that company was making it. I won't say how much lower, because it was so much lower that you would be rather surprised, but taking that balance sheet for a year and analyzing it as I did I found that the oven put it in very much less, and the very best evidence of that fact, gentlemen, is this: That very recently arrangements have been made with that company to put in to the extent of 2,500,000 feet a day gas from coke ovens at a considerable less rate than the gas companies to whom it is being supplied can make it. That is the best evidence you could ask. Somebody has said that "The proof of the pudding is in the chewing of the string," and the best way for a man to back up his argument is to show what is actually being done. That contract has been undertaken to the extent of 2,500,000 per day at a price less than the gas company can make it. I think I have proven my point, Mr. President.

MR. MILLER:—I would like to ask Dr. Schniewind what would be the relative value of coke produced in beehive ovens as compared with by-product ovens for foundry or metallurgical purposes, coal in both plants from the same mine, in other words of the same grade; what would be the relative value of the coke?

DR. SCHNIEWIND:—I understand your inquiry to be whether there is any difference in the value of coke produced in retort ovens from certain coal, and by-product coke produced from the same coal, and from many trials, I can say that, if anything, the by-product coke is superior to the beehive coke.

MR. MILLER:—No; my question is the relative value of the coke from a by-product oven and the beehive oven, using the same coal.

DR. SCHNIEWIND:—With your permission, Mr. President and gentlemen, I will enlarge on this question a little bit. You know that beehive ovens are not good coking ovens for a great number of coals, so in order to answer this question fully I will say that we have taken the very best coking coal which can be found for the manufacture of metallurgical coke, namely, the Connellsville coal. We coked about 3,500 tons of this coal in our Otto-Hoffmann ovens and tested the coke in a blast furnace. After a trial period on the Connellsville beehive coke the by-product coke was changed. The coke consumption per ton of pig iron on the by-product coke was about 98 pounds less, while the capacity of the furnace increased 8 per cent. The reason for this is chiefly the

greater density of the by-product coke. It is made in a deeper layer and consequently denser by compression. It therefore takes less volume in the blast furnace, allowing a larger ore charge to pass through the blast furnace in the same period of time. The Cambria Steel Company operates 160 ovens of our type and have used our coke in comparison with beehive coke for a very long period of time—several years, and recently when an extension of the plant was under discussion they once more made tests for several months. They took two furnaces, running them during the same month, one on beehive coke and the other on by-product coke. They made their observations during the same period of time in order to have no difference in weather conditions which might very materially influence the operation of a furnace. After this was done and the advantage of the by-product coke was shown by the operation of the two furnaces, they changed around. The furnace which was previously operated with by-product coke was used to test the beehive coke and *vice versa* in order to eliminate any difference in the operating of the individual furnaces, and the same results were obtained. The by-product coke was found to be ahead.

Mr. Miller:—In that case I would like to inquire why beehive-oven coke sells from 40 to 60 cents per ton more than by-product coke for foundry purposes.

Dr. Schniewind:—Simply because it is a new thing, and by-product coke has to overcome a great deal of prejudice. We have about overcome this prejudice. The by-product coke ovens, when they were first introduced, were stated to make a coke very much inferior to beehive coke, and we have had to make inducements in the price of coke in order to find a market. But recently we have had to make no such reduction. We are now getting just the same price for the by-product coke as is obtained for the beehive coke, because we have demonstrated the equality of both cokes.

E. D. Johnson:—In regard to this matter with reference to the use of coke, I will simply say that we have in our foundries adopted the by-product coke, and we find that the statements of Dr. Schniewind are fully carried out. In fact, we prefer the by-product coke for our foundries' use.

Mr. Andrews:—In this connection I might say that although we have been in operation only a short time we have developed a market as stated in my paper, for our coke, which is largely

in excess of what we can supply, and at the present time we are not taking contracts at less than the Connellsville coke in most of the territory we are supplying. Of course there are some points where we are still developing our business, and where we are making special rates to get in, but in the other part of our territory our prices are as high as the Connellsville coke at the present time.

Mr. Littlehales:—I would say I can endorse every word of Dr. Schniewind's in respect to his experience with reference to the relative efficiency of retort-oven coke as compared with beehive. The same thing has been demonstrated in a dozen places at least. I instanced one in my paper where the parties were using both. The question Mr. Miller raised about having to sell it at a lower price is as universal as business. Wherever a new competitor comes in, in any line, I do not care what it is, as a new competitor, he has, at the start, to put his prices lower, because there is always a reluctance to change. A man or a firm may be doing business in a certain line and he does not care to change from that line unless he can get an advantage. What advantage can you offer if you have a new article on the market? You have to give them a little lower price until you satisfy them that your article is the right thing. Then it will fix its own price. It is no reflection on by-product coke that in some cases it has to be offered at a lower rate to induce its sale. That is simply common to all kinds of business the world over.

Mr. Miller:—Mr. President, inasmuch as Mr. Carpenter has been unable to get a direct answer to his question, I would like to ask Mr. Littlehales what large gas-works in the state of Ohio it was in which he made his comparison?

Mr. Littlehales:—I did not say it was a works in this state. I said in this country. My estimates ordinarily are taken per carbonization at 95 cents per ton in the gas works. And from a great many gas-works from which I have the data I find it exceeds that in a great many more cases rather than where it falls below it, where I have been able to obtain data, but where my estimates were made they have been made on the basis of 95 cents for carbonization wages in gas works. The case I referred to was the actual cost of wages paid in that locality. I was simply giving the result as a comparison of the two methods, and I could not make a better estimate than by taking actual facts; I know these works are run economically, but 95 cents per ton is the cost which I estimated.

Mr. Miller:—I wish to state in reply to that that although that plant may have been operated econmically it was about 80 per cent. higher than it should have been with the modern coal-gas plant.

Mr. Carpenter:—I would like to ask Mr. Littlehales if that 95 cents per ton is the total works labor or the cost of the retort labor?

Mr. Littlehales:—It would embrace all the carbonization wages, which includes the coke handling; the getting in of the coal, the charging of the retorts, and taking away the coke from retorts, and all the labor pertaining to carbonization which would apply in both cases; and with all due respect to Mr. Miller, except where machinery is employed, I would like to see some data by which you could show me how it can be done 80 per cent. cheaper. I have figured it out from a great many standpoints, and I find that the coal handled per man in the average retort system will run, if I remember right, about 2½ tons per man per day. It is easily figured out. Most of us have to pay about the same general run of wages for a man, and I do not see how it is possible to cut 80 per cent. off of that, because even inclined retorts do not gain that.

Mr. Miller:—Mr. Littlehales did not quite understand me. I did not say he could cut 80 per cent., but I said that 95 cents was 80 per cent. too high.

President Doherty:—In other words, about 50 cents would be right; is that correct?

Mr. Miller:—Yes, sir.

President Doherty:—What figures did you have in mind, Mr. Miller, if you please?

Mr. Miller:—Approximately, 50 cents.

President Doherty:—Mr. Carpenter, do you think that figure is a representative figure?

Mr. Carpenter:—Well, the reason I asked that question of Mr. Littlehales was because I was afraid he was making comparison between an ordinary coal-gas plant that was a little out of date and a modern coke-oven plant which was thoroughly equipped with labor-saving machinery. I should think Mr. Miller's figures, from what I know of it, are a little high, if anything.

Mr. Littlehales:—Perhaps there may be some little discrepancy which is the cause of the misunderstanding on this point. My figures on coal-gas or retort working do not apply to where water-gas is used in conjunction, but I am speaking of straight coal-gas.

President Doherty:—I think the point they are trying to bring out is this: That you are taking a works where they are using no drawing or charging machinery.

Mr. Littlehales:—Certainly.

President Doherty:—And the carbonization labor of works of that sort will often run $1.10 per ton of coal; while, taking a very conservative estimate of figures which are being obtained in this country, you can cut it down to 50 cents a ton, including all coal-carbonizing labor, with drawing and charging machinery, and I personally believe that you can cut it down to 35 cents.

Mr. Littlehales:—I believe that is possible, and I wish to say that there are probably only two or three places on the continent of America where the gas is made in sufficiently large volumes to justify that, but in the average gas-works, without machinery, I still hold that 95 cents would be lower rather than higher than the average.

Mr. Carpenter:—There has been quite a number of coke-oven plants built of late. There have been very few modern installations with retort houses, equipped with machinery. Possibly a few years hence there will be a few plants so that we will be able to make a respectable comparison. I speak of small-sized plants now in reply to Mr. Littlehales' point in reference to small plants.

Mr. Littlehales:—I referred to a plant of 2,000,000 a day.

Dr. Schniewind:—We have lately, in our modern plants, adopted a great number of labor-saving devices, so that I think I can answer this question to some extent. We figure—and can bear this matter out by facts—that taking the coal from the railroad cars, dumping it, passing it through the crusher, elevating it into a bin, charging it by electrical machinery into the coke ovens, raising the doors, pushing the coke out on a platform, quenching the coke, dumping it into railroad cars, and furthermore, tending to the gas mains as far as the condensing house inlet, cleaning the mains of pitch, etc., our labor costs us 22½ cents per net ton of coal carbonized. That is with all of these modern equipments, electric pushers, electric drawing machinery, electric coke charging machinery, etc.

Mr. Carpenter:—Taking these figures and figuring on 4,000 cubic feet of gas per ton against 10,000 that you get in the ordinary retort house from the gas end of it, I fail to see where the profits come in.

DR. SCHNIEWIND:—If Mr. Carpenter will also take into consideration the other side of the balance sheet, and make due allowance for tar, ammonia, and other by-products with the larger percentage of coke that the ovens turn out, he will see that it more than covers the difference which he mentions.

MR. LITTLEHALES:—I would like to explain, Mr. President, wherein the discrepancy occurs in Mr. Carpenter's mind. If you sell 900 pounds per net ton of coke in the average gas-works, that is about all you sell, but you can sell 70 per cent. of its weight from by-product ovens. I think if you will figure that up when you get home, and take a little time to it, you will find where it comes in.

MR. CARPENTER:—There is another point which must be considered, and that is, the relative cost of installation of the two plants. You have to pay interest on the money you have invested in the plant.

DR. SCHNIEWIND:—I want to say, Mr. Carpenter, that of course local conditions will govern. The coke oven is not the salvation for every single point. As has been brought out several times, Mr. Carpenter should bear in mind that millions upon millions of tons of coke are being produced in this country with an absolute waste of tar, ammonia and gas, and the manufacture of this coke has gone on successfully so far, notwithstanding this waste. Furthermore, by-product coke ovens are operated by the thousand with a waste of all the gas, and notwithstanding this waste, they are paying large dividends. Bear these facts in mind, and you will understand that if the gas is put into proper shape, which is done without any expense to speak of at all, that there must be a great saving resulting therefrom.

MR. MILLER:—I would like to ask Dr. Schniewind what would be the effect upon the price of tar and ammonia had all the coke been produced by the by-product ovens rather than the beehive ovens?

DR. SCHNIEWIND:—I want to say that the demands for ammonia are simply in their infancy. The bringing of more ammonia into the market has increased rather than decreased the price. When we started out with the first plant, which was built in 1895 and enlarged in 1898—the plant of the Cambria Steel Company at Johnstown, Pa.—everybody said that the ammonia market would go to pieces, and so it did temporarily. The introduction of the by-product coke ovens into the United States made

a very marked impression on the price of by-products in the beginning. After the erection of the Cambria plants, and when the Glassport plant came into operation, the price of sulphate of ammonia fell from $53 to $40 per ton. Then we looked into the cause of the trouble, and found that it was partly due to the clever manipulation of prices by brokers, bidding the two products against each other. We prevented a recurrence and the price of sulphate of ammonia has continuously gone up until at present it is $58 or $59 per ton, and there is an increasing demand all the time. The demand is so large that the present product is not nearly sufficient to supply it. The production of sulphate of ammonia since 1895 has more than doubled. Furthermore, I would like to call your attention to the fact that immense quantities of nitrate of soda, which is another nitrogenous fertilizer—are brought into this country. The present importation, I think, is about 400,000,000 pounds per year. About 75 per cent. of the nitrate imported into other countries is used for fertilizing purposes. I speak especially of Germany, which uses about 450,000 tons. Now as soon as the sulphate of ammonia, which is a domestic product, is brought properly before the farmer, it will have exactly the same success as in other countries. It will be adopted by farmers for fertilizing purposes because it has been demonstrated that it is a good fertilizer. The domestic production of ammonia by gas-works is comparatively small, and the product from the coke ovens coming upon the market at first caused alarm, but this has been entirely unfounded, because the entire coke-works production has been not only disposed of mostly on long-time contracts, but the importation of sulphate of ammonia into this country has greatly increased since the introduction of by-product coke ovens. This proves that the supply created the demand. The consumption and production of sulphate of ammonia in Germany and England are very much larger than in the United States, notwithstanding the fact that the United States has become the leading manufacturing country in the world.

In regard to tar, it may be stated that the production in England and Germany is also very much larger than in the United States. England produces per year about 750,000 tons of tar. Germany produces about 450,000 tons, while this country produces about 200,000 tons, notwithstanding we have a very much larger population and very much larger industrial development. It is only a question of the supply creating the demand. The use of tar

is continuously increasing for many industries, and since the introduction of the by-product coke oven no material reduction in the price of tar has been experienced.

MR CARPENTER:—I do not wish to be misunderstood altogether in this discussion. I do not question the field of the by-product coke oven, but I do believe that in any case it comes down to a question of whether you are in the gas business or whether you are in the coke business. I think that you can get out of a pound of coal to start with, enough in the ordinary retort process, as used by gas companies, to put gas into the holder just as cheap as you can by the coke-oven process. If you want to make coke, or if you are going into the coke business, then that is another matter to be considered.

MR. MILLER:—Mr. President, I think that Dr. Schniewind did not quite understand my question. I asked particularly what would have probably become of the price of coke to-day, had all the coke been produced by by-product coke ovens last year, rather than by beehive ovens?

DR. SCHNIEWIND:—I beg your pardon. I thought your question referred to the by-products. I want to say that this question may be answered by the results which have been obtained in other countries, where by-product ovens have been adopted more universally, especially in Germany. There is absolutely no difference in the price of beehive coke as compared with by-product coke. In my paper, in speaking of that feature of the discussion, I had reference to the condition a few years ago, when there were still beehive ovens in existence in Germany. Now, *all* these beehive ovens have disappeared in Germany. There are absolutely none. This substitution of by-product ovens has had no effect on the price of coke. In other words, as I understand your question, it is whether the price of by-products and coke will have to be lowered in order to find a market. I have no hesitancy in stating that such has not been the case. The price of coke has always been established on the beehive cost basis.

MR. LITTLEHALES:—Allow me just one word along the same line. I would like to answer Mr. Miller's question in this way: If 30,000,000 net tons of coke are used in metallurgical purposes, it matters not in affecting the price of that article, whether it be made by the beehive or by retort ovens. But if that 30,000,000 net tons that were carbonized by the beehive ovens, from which the tar, ammonia and gas were wasted, it would simply mean a

saving in that operation of enough gas to light 433 cities, allowing them 4,000 per capita. As far as the effect on the price of coke is concerned, I cannot see how it would effect it whether the 30,000,000 tons were made by beehive ovens or retort ovens.

PRESIDENT DOHERTY:—I will now ask Mr. Russell to read his contribution on the subject, "The Relative Economy of Full-depth and Half-depth Benches."

RELATIVE ECONOMY OF FULL-DEPTH AND HALF-DEPTH BENCHES.

D. R. RUSSELL.

At the request of your Secretary I have prepared a few notes in answer to the question, "Is there any economy in full-depth benches over half depth, and why?"

I consider that it depends entirely on local conditions whether full-depth recuperator benches or half-depth recuperator benches are the better, or in fact, if any recuperator benches are better than the ordinary free fire. In a very small gas-works producing, say, not over 10,000 to 15,000 feet per day, I would not advocate using recuperator benches at all, as the saving would practically be nothing, and no compensation would be derived from the increased cost of installation.

Where the output reaches a maximum of 80,000 cubic feet a day, and from that up to 250,000 feet, I would recommend half-depth recuperator benches. For the former output probably a bench of 4's and a bench of 6's would be the best calculated to handle the production with economy, and for the latter from four to five benches of semi-recuperator 6's with furnaces in front or rear. From 250,000 to 500,000 feet I would advocate full-depth benches of 6's. This would also cover what is sometimes called three-quarter-depth 6's, which, however, are practically full depth, and give about as good results as a bench which may be constructed with possibly a foot or more of deeper furnace and recuperation.

When the output is 500,000 feet, I would unquestionably advocate either full-depth benches of 8's or full-depth benches of 9's, preferably the latter. I am aware that there is considerable prejudice against benches of 9's, but my opinion is that the failure to get all-around good results from 9's is from the fact that the benches are improperly designed, constructed or operated. There are sufficient benches of 9's which have been under continuous

operation for some years in the United States which have given most excellent satisfaction, and whereas, it is generally found that the center bottom retort will give out before the balance, it is a fact that you will get at least 90 per cent. as much gas from this said retort as from any of the balance of the retorts in the bench, and when it becomes necessary to block this retort off you have merely exchange a bench of 9's for a bench of 8's for the few months of life remaining to the retorts.

The average cost of installation of benches of different kinds, including only the benches proper, which covers the arches from the top of the foundation, the retorts, settings, iron work, and everything erected complete ready for off-take connections to be made, but not including retort house or floors, is about as follows:

Semi-recuperator 6's	$31.66	per 1,000 feet capacity
Full-depth 6's	41.66	" " " "
Full-depth 9's	33.00	" " " "

I think a fair average year in and year out of the amount of coke used under the benches per 100 pounds of coal carbonized would be for

Semi-recuperator 6's.	17½ pounds,	or 27% of the coke made.
Full-depth 6's	16¼ pounds,	or 25% of the coke made.
Full-depth 9's	13 pounds,	or 20% of the coke made.

Figuring on an average output of 500,000 cubic feet per annum, and estimating on securing 65 per cent. weight in coke from the coal carbonized, you would have for sale the following amounts of coke per annum, and assuming that the coke would be sold at $3.50 per ton, the saving between the different kinds of benches would be as follows:

Coal carbonized per annum, estimating 5 cubic feet of gas per pound, 18,500 tons, producing 12,000 tons of coke.

From half-depth benches 6's, there would remain for sale, 8,760 tons at $3.50	$30,660 00
From full-depth benches 6's, there would remain for sale, 9,000 tons at $3.50	31,500 00
From full-depth benches, 9's, there would remain for sale, 9,600 tons at $3.50	33,600 00

The estimated saving, therefore, for the year is:

For full-depth 6's over half-depth 6's	$ 840 00
For full-depth 9's over half-depth 6's	2,940 00
For full-depth 9's over full-depth 6s'	2,100 00

It is very difficult to secure accurate information as to results obtained, but the above figures are taken from the average results reported from a number of gas-works.

Referring to the local conditions which should govern the installation of different classes of benches, there are sometimes many reasons why it is preferable to use one or the other kind of construction. It is sometimes the case, owing to the lay of the ground, that railroad switches may come above the level of a stage floor, and that the whole coal supply may be above the level of a stage floor. In this event it is more convenient to have the full-depth benches, even where only a few are required, the coal coming in at the stage door level, and the coke being dropped through into the basement and taken out on the yard level, which, owing to the character of the ground may be many feet lower than the coal supply.

Another advantage of full-depth benches is that you can install if desired, coke-conveying machinery beneath the stage floor, which cannot be well adapted to half-depths as it interferes with the operation of the furnaces, the height being so limited.

On the question of repairs there is another advantage for the full-depth benches. Whereas you can, where half-depth benches have not been abused, reset the retorts over the recuperation a second time, it is a question if a third setting should go in; but with full-depths you should be able to reset three times, making four settings before rebuilding.

I would not advocate attempting to build either benches of 8's or benches of 9's with anything but full-depth furnaces and recuperation, as it is impracticable to design either class of bench on half-depth lines without having the retorts too close to the furnace arch, and being unable to carry sufficient fuel to assure the production of carbonic oxide in the furnace, and the danger of the fuel bed becoming so thin as to cause direct combustion, and the destruction of the furnace arch and the retorts. This does not apply to benches of 8's or 10's built in two rows of retorts set vertically four or five tiers high which are used abroad in some instances, and which are to be installed in the United States, for the reason that where such benches are operated it is obviously necessary to utilize charging and drawing machinery, which brings in an element of expense which I assume is not intended to be covered by this question. Such benches, I believe, however, would also necessitate the deep furnace and recuperations to get high and even heats with economy of fuel.

President Doherty:—Gentlemen, we have a written discussion on the subject of "Isolated Generator Firing of Benches," in which one of the contributors in a measure sought to touch upon this point. I am inclined to think that it would be advisable to read the contributions on that subject, and that it will open up the whole proposition of fuel economy in the retort house, and the entire subject, including the contribution of Mr. Russell, can be discussed at the same time.

At the request of the President, Vice President Andrews then took the chair.

W. E. Steinwedell's written discussion on the subject of isolated generator firing of benches was then read as follows:

ISOLATED GENERATOR FIRING OF BENCHES.

W. E. STEINWEDELL.

Your President has asked the writer to start a discussion on "The Firing of Coal Gas Benches with Isolated Generators," and the following views are submitted for this purpose.

First Cost in this style of construction depends on whether the primary and secondary air is heated, and will be increased if a duplicate set of generators is installed for facilitating repairs and getting an even production of generator gas.

The question of the number of retorts each generator or pair of generators will most economically heat has not been established.

Cost of Operation: The repairs on the benches will depend on the evenness of temperature maintained; but should be small, as retorts will last for a long time if fired with a steady supply of gas. The generator requires new lining and grate bars occasionally.

Labor for drawing and charging is the same with benches of the ordinary type; whether horizontal hand charged, machine charged, or inclined settings. The supervision of attending the generators, regulating the heats of the benches and running forced draft in some cases should be lower than with individual generator settings.

Fuel for firing can be either coal or coke; excepting when the construction produces tar and lampblack in the flues when fired with coal. Radiation plays an important part in fuel consumption.

Reliability of these benches under continuous operation depends on a constant and even production of gas in the generator to produce steady heats, and the valves for controlling the entrance of the generator gases into the bench should close air tight to prevent an explosion.

HENRY L. DOHERTY then read his contribution on the same subject as follows:

ISOLATED GENERATOR BENCH FIRING.

HENRY L. DOHERTY.

Isolated generator bench firing has been frowned upon by gas engineers to a degree entirely unwarranted by results obtained in similar applications of producer gas firing in other industrial plants.

There is little in Mr. Steinwedell's views which I care to take exception to, but I do not think he has fully set out the advantages of producer gas firing, and has entirely overlooked the saving which can be made by the use of breeze and other low priced and less vauable fuel which can be used in a producer, but cannot be used in our present furnaces advantageously, and he also omitted to call attention to the income that might be derived from tar and ammonia, to be obtained from producer gas furnaces where coal is used. On the other hand, he did not call attention to one serious objection to producers, which is their small capacity per unit surface of grate area. From 10 to 20 pounds of fuel is about all they can gasify, and 15 pounds might be taken as a fair average.

The first cost of installation for producer gas firing would be more than our present cost if we had to adapt this method to our present installations, but I believe it would be less if we were building anew with this end in view.

The furnace labor and attendance should be very much less than with individual settings. It is less labor to care for one large furnace than several small ones, and especially where this large furnace, or battery of large furnaces, can be properly situated and arranged for the reception and stoking of the coal and the disposal of the ashes.

Gas firing at Columbus has demonstrated that a much longer life of settings may be expected, and a much lower cost of maintenance.

I believe producer gas can be made, washed, cooled and stored, if desired, and still the fuel economy of producer gas firing will compare favorably with our present methods, making no allowance for saving in labor, saving in life of settings, saving by use of a fuel of lessor cost, and the saving resulting from residuals of the producer gas furnace.

I do not think the radiation and other losses of the producer would exceed the present losses of heat in our waste products of combustion, which cannot now be advantageously recovered, but which could be very readily recovered to a large degree if producer gas firing were adopted. It is very doubtful if any great fuel economy results from pre-heating our primary air, as we must keep the temperature in our furnace below the fusing temperature of the ash, and, if we heat our primary air, we must add enough more water to bring the temperature of the furnace down to the desired point. I will therefore confine my comparisons to those benches where only the secondary air is pre-heated, leaving the relative merits of full-depth and half-depth benches to be fought out by others.

If we assume that our gases have a temperature of 2,500 degrees Fahr. at the entrance of the recuperator flues, and that 1/6 of all our coke must be gasified with water to keep the temperature of our fuel bed below the fusing point of ash, then we may safely take the following figures as a fair indication of the waste in our flue gases:

5 pounds C burned with 57.75 pounds air (44.44 N.) to 1833 pounds CO_2=5 pounds x 14,544 B. T. U.=....	72,720	B. T. U.
1 pound C burned with 1.50 pounds water (.166 H) to 2.33 pounds CO=1 pound x 4,400 B. T. U.=......	4,400	
2⅓ pounds CO burned with 5.77 pounds air (4.44 N.) to 3.66 pounds CO_2=2⅓ x 4,348 B. T. U.=..........	10,141	
Total heat combustion............................	87,261	B. T. U.

HEAT LOSSES IN FLUE GASES.

1.5 pounds H_2O from 60 degrees to 212 degrees Fahr......	228	
1.5 pounds H_2O latent heat at 965.7 B. T. U. per pound....	1,448	
1.5 pounds H_2O entering flues at 2,500 degrees Fahr.=1.5 pounds x .48 (sp. h.) x (2,500 degrees—212 degrees)=	1,647	
22 pounds CO_2 entering flues at 2,500 degrees Fahr.=22 x .2164 (sp. h.) x (2,500 degrees—60 degrees)=......	11,616	
48.88 N entering flues at 2,500 degrees Fahr.=48.88 H x .244 (sp. h.) x (2,500 degrees—60 degrees)=...........	29,101	
4.44 N entering flues at 2,500 degrees Fahr.=4.44 N. x .244 (sp. h.) x (2,500 degrees—60 degrees)=...........	2,645	
Total loss		46,685

Recovered by absorption in secondary air, which would be one-half of 57.75 pounds air=
28.87 pounds to burn 5 pounds Carbon to CO_2 and
5.77 pounds to burn 2⅓ CO to CO_2 and
5.77 pounds to burn 0.166 pounds H to H_2O, making in all

40.41 pounds.

Total heat absorbed=40.41 pounds x .2379 (sp. h.) x (2,500 degrees—60 degrees)= 23,457
Net loss 23,228

$$\text{Efficiency } \frac{\text{Left for useful work......64,033}}{\text{Total heat developed.....87,261}} = 73.4 \text{ per cent.}$$

This would give the flue gases a specific heat of .2405 and the temperature of the escaping gases would be 1,124 degrees+60 degrees = 1,184 degrees Fahr. This temperature is 200 degrees Fahr. in excess of our observed temperature at Denver on some recent tests we have been making on our benches, but our observations were so unsatisfactory that we do not place much reliance upon them. If temperature of the furnace is 2,500 degrees Fahr., as we believe it is, there is some error affecting our flue-gas observations which we have not yet located. This apparent difference would be lessened, however, were we to correct for a slight excess of secondary air which we admit and also correct for the higher specific heat of the moisture contained with the air taken in for secondary combustion. Before completing our experimental work at Denver we will obtain an agreement between the observed and calculated temperature.

Now let us trace through the losses of producer gas firing. I think we can safely assume that the temperature of outgoing gases will not exceed 960 degrees Fahr. when properly operated.

3 pounds C burned with 17.32 pounds air (13.32 N.) to 7 pounds CO=3 pounds x 4,400=..................	13,200 B. T. U.
1 pound C burned with 1.50 pounds H_2O (0.166 pounds H) to 2⅓ pounds CO=1 x 4,400=..................	4,400 B. T. U.
Total heat production	17,600 B. T. U.

HEAT LOSSES IN PRODUCER FIRING.

9.33 pounds CO leaving producer at 960 degrees Fahr.=9.33 pounds x .248 (sp. h.) x (960 degrees—60 degrees)=	2,082	
13.32 N. leaving producer at 960 Fahr.=13.32 pounds x .244 (sp. h.) x (960 degrees—60 degrees)=.............	2,925	
.166 H. leaving producer at 960 degrees Fahr.=.166 pound x 3.4 (sp. h.) x (960 degrees—60 degrees)=........	507	
1.5 pounds H_2O dissociated=1.50 pounds x 6,900 (h. of d.)	10,350	
1.5 pounds H_2O raised from 60 degrees—212 degrees=1.50 pounds x (212 degrees—60 degrees)=...............	228	
Losses at producer outlet		16,092
Leaving for radiation and other losses		1,508

We now have 9.33 pounds CO yielding .933 pounds x 4,348 (h. of c.)=	40,566	B. T. U.
We now have .166 pounds H yielding .166 pounds x 53,410 (h. of c.)=	8,866	B. T. U.
Total value	49,432	B. T. U.
We now have 4 pounds carbon used=4 pounds x 14,544 (h. of c.)=	58,176	B. T. U.
We now have left for useful work	49,432	"
We now have loss in producer and sensible heat	8,744	B. T. U.

We now have efficiency $\frac{49,432}{57,176}$ =84.1 per cent.

I do not think this efficiency is at all beyond what we can obtain in everyday practice.

In burning this gas in the bench we will pre-heat both the incoming gas and the incoming air by the waste products of combustion. In this calculation made on our present methods I allowed no loss in transmitting the heat through the walls of the recuperator flues, but in this case I will assume an efficiency of approximately 84 per cent. and admit that we may have to use supplemental iron recuperator to get that.

9.33 pounds CO burned with 23.09 pounds air to (17.76 pounds N.) 14.66 pounds CO_2=9.33 pounds x 4,348 (h. of c.)=	40,566	B. T. U.
.166 H. burned with 5.76 pounds air to (4.44 N.) 1.50 H_2O =1.50 x 53,410 (h. of c.)=	8,866	
Total heat of combustion	49,432	

PRODUCER HEAT LOSSES PRE-HEATING GAS AND AIR.

N from producer=13.32 lbs.
N added at furnace=........17.76 lbs.

N total	31.08 lbs.×.244	(sp.h.)×(2,500°—60°)=	18,958	B. T. U.
CO	14.66 lbs.×.2165	(sp.h.)×(2,500°—60°)=	7,740	"
H_2O	1.50 lbs.×.48	(sp.h.)×(2,500°—60°)=	1,767	"
Total loss, B. T. U.				28,465

Recovered by absorption in ingoing gas and air.

CO 9.33 pounds×.248 (sp. h.)×(2,160 degrees—60 degrees)=	4,859	
N 13.32 pounds×.244 (sp. h.)×(2,160 degrees—60 degrees)=	6,825	
H .166 pounds×3.4 (sp. h.)×(2,160 degrees—60 degrees)=	1,183	
Air 28.85 pounds×.2,379 (sp. h.)×(2,160 degrees—60 degrees)=	14,343	
Total recovery		27,210
Net loss, B. T. U.		1,255

4 pounds carbon-heating value		58,176
Loss in producer	8,744	
Loss in furnace	1,255	
Total loss		9,999
Left for useful work		48,177

$$\text{Efficiency} = \frac{47,177}{57,176} = 82.8 \text{ per cent.}$$

I know these figures will prove somewhat startling to some of my friends who are ante-producer men, and even after assassinating my estimates and substituting their own they will not be able to bring the results to the low value they now have in their mind. Here is a simple explanation which will perhaps appeal to all.

Neglecting the water used in our furnaces 11.54 pounds of air are required to burn 1 pound of carbon.

5.77 pounds of this is primary air.

5.77 pounds of this is secondary air. We heat the secondary air only, or we heat but 50 per cent. of the air (by weight) and this 50 per cent. of air is but 46.01 per cent. of the flue gases. The specific heat of flue gas of this composition would be .238, while the specific heat of air is .2379 and the secondary air has thermal capacity for only 45.9 per cent. of the heat contained in the gases.

Taking the two conditions I have assumed in my comparison between our present method of firing and firing with producers, the secondary air in the first example is 48.1 per cent. of the products of combustion and has capacity for 47.6 per cent. of the heat contained in the gases. Taking the conditions I have assumed for producer gas firing the ingoing gas and air is equal in weight to the outgoing gas, and has a higher specific heat. Their thermal value is .2502 against .2467.

I append a tabulation of assumption to enable any one desiring to do so to check my computations on the data I used. The foregoing figures are only intended to be approximately accurate.

ASSUMPTIONS.

SPECIFIC HEAT.

Air	0.2379
O	0.2182
N	0.2440
H_2O (water)	1.000
H_2O (vapor)	0.480
H	3.400
CO_2	0.2164
CO	0.248
C	0.20

HEAT OF COMBUSTION.

C to CO	4,400
C to CO_2	14,544
CO to CO_2	4,348
H to H_2O (water)	62,100
H to H_2O (vapor)	53,410

1 pound H_2O (water)=in dissociating absorbs 62,100÷9=6,900 B. T. U.
1 pound H_2O (vapor)= " " " 53,410÷9=5,934 "
12.54 pounds flue gas consisting of 2.66 pounds CO_2 9.88 pounds N.
8/9 pounds O burning to CO = (3/4 x 8/9) x 4,400 =.... 2,933 B. T. U.
1 pound H_2O (water) to H and CO absorbs.............. 3,969 "
1 pound H_2O (vapor) to H and CO absorbs .... 3,001 "
5.77 pounds of air required for secondary combustion.
5.77 pounds " " primary "
11.54 pounds total air required for combustion.
Making with 1 pound C 12.54 pound flue gases consisting of 2.66 pounds CO_2 and 9.88 pounds N.

THERMAL CAPACITY.

2.66 pounds CO_2 x .2164= .5756
9.88 pounds N x .244=2.41

12.54 pounds 2.9856
Average specific heat 0.238.
Thermal capacity of 5.77 pounds air at 0.2379=1.372683.

$$\frac{\text{Air}}{\text{Flue gas}} = \frac{1.372683}{29856} = 45.9 \text{ per cent.}$$

$$\frac{\text{Air}}{\text{Gas}} = \frac{5.77}{12.54} = 46.01 \text{ per cent.}$$

Air consists of 23 parts O by weight and 77 parts N by weight.
Each 100 parts of O must then carry 3.33 parts of N.
Assume producer gas is discharged at 960 degrees Fahr.
Sp. H.—Specific heat.
H. of C.—Heat of combustion.
Heat of D.—Heat of dissociation.

DISCUSSION.

VICE PRESIDENT ANDREWS:—Gentlemen, you have heard these very interesting contributions, and I think probably the best way would be to take up first a discussion of the half-depth and full-depth furnaces which were so ably treated by Mr. Russell. I will call on Mr. Dell.

JOHN DELL:—Mr. President, I did not come prepared to discuss that paper as I noticed it had been eliminated from the report I got of the contemplated proceedings. But I have no doubt Mr. Russell has covered the question pretty thoroughly. It seems to me that the question of full-depth and half-depth furnaces is a matter of condition and depends entirely upon the demands required. As regards the value of the half-depth over the free-firing furnaces everybody acknowledges the advantage of the former over the latter. It depends upon the unit of out-put of the plant as to what sort of benches one ought to install, whether 6's or 9's, just as it is for a furnace. When it comes to a question of economy everybody will acknowledge that the regenerator furnace is something which we should all consider favorably. Every engineer who has used a regenerative furnace acknowledges its advantage over the free-firing furnace. The question of cost is one that will have to be considered as well as the requirements of the plant. I do not think anybody would question the value of the system of full-depth firing over half-depth. Probably the most desirable construction in some plants would be the rear-clinkering style of bench. There are advantages in that form of bench which will present themselves to anybody who has fully considered it. The objectionable feature of a pit in front of the bench is avoided by this style of construction, and the retort house is kept free from the ordinary fumes and smoke, and is thus rendered very much cleaner. Besides, it gives you the advantage of a solid floor. A great many plants are so located that they cannot use a stage floor. And they can get the benefits of half-depth or full-depth furnaces in the rear-clinkering system, and do away with all of the objectionable features of a stage floor and pits. The economy of running the rear-clinkering bench is just the same as a furnace would be in a front-clinkering bench, half or full-depth furnace. I have not made any calculations as to the consumption of fuel in these different styled benches because I did not think the question would come up.

PETER YOUNG:—I have no doubt that with full-depth furnaces you can get better results than with half-depth, but I think it is a question of location and local conditions entirely whether the saving of fuel will pay the interest on the extra investment required. Those are all local conditions which have to be taken into consideration by each engineer in his own town.

MR. MILLER:—We have put in full-depth furnaces altogether for the reason that we think they are not only better and have better effieciency than half-depth furnaces, but also it is more economical for us to reconstruct them by reason of the fact that we are compelled to put our operating floor above the flood line of the Ohio river, which necessitates putting the floor line of the retort house about 15 feet above the street line. As to the amount of coke used in the different furnaces I think that a bench of 6's can be operated just as economically as benches of 8's or 9's; no difference whatever.

VICE PRESIDENT ANDREWS:—Mr. Mason, will you give us the benefit of any suggestion you may have on this subject?

MR. MASON:—Mr. President, I am not prepared at all to say anything on this subject. We have benches of 9's. They are full depth. We are getting very good satisfaction out of them, and they are run very economically. The percentage of coke used in our furnaces runs about 20 to 25 per cent.

VICE PRESIDENT ANDREWS:—We would be very glad to hear a discussion now of Mr. Doherty's paper in relation to isolated bench firing, if any one feels like offering any suggestions on the subject.

MR. RUSSELL:—I would like to ask Mr. Doherty if he advocates the producers being built so that the gas is carried into the holder and then heated, or whether he would advocate using hot gases direct from the producer.

HENRY L. DOHERTY:—Mr. President, we have more waste heat going out of our present flues than we can use. Now there is no object in saving the sensible heat of producer gas, therefore I would advocate cooling and storing it in a small holder for the sake of uniformity and to take care of any temporary shut-off. This discussion started some five years ago when the Columbus Gas Company was seriously considering the erection of a new retort house at the plant where they built their large holder. I advocated the use of producer-gas firing. It was opposed to a large extent by everybody I proposed it to, and it resulted in Mr.

Thompson taking it up and giving it some investigation. The question was argued at the Milwaukee meeting of the Western Association, but not very effectively. Mr. Bredel is a pronounced opponent to producer-gas firing, and I was really the only advocate in favor of it. Neither one of us touched to any great extent upon any vital point. Mr. Bredel brought up some objections that had not occurred to me, and since then I have gone over them as far as I can without making an actual experiment, and I believe that all of those objections are unfounded. There has never been an installation of producer-gas firing in this country in recent years since that controversy started except at the New England Gas and Coke Company's works, where, I believe now they sometimes use producer gas to fire their coke ovens; and in blast works, steel works, and in other industrial plants they are successfully using producer gas for firing furnaces, very similar to our coal-gas methods. With a producer-gas furnace you can use coke if you want to, and you can use low grade fuels that you cannot use in our present furnaces. As our present furnaces are constructed they are the worst possible form of construction for good fuel results. The ideal condition for a producer-gas furnace would be maximum area and minimum wall surface. In our present furnaces we have a long narrow furnace which gives a maximum wall surface and a minimum area. It is impossible to keep all of these furnaces at a high efficiency. If you are firing with gas you could set your valves, and I don't think you would have to pay any more attention to them at all. You would have all of your fuel results under charge of one man or one corps of men, and there is a great saving which might be made in the fuel results of the ordinary gas-works, and there also might be more or less labor saved on furnace work. Our fuel now costs us from 20 cents to $1.30 per ton of coal carbonized, and a bigger opportunity for saving is open there than in almost any other branch except retort-house labor.

Dr. Schniewind:—Anyone who has watched the operation of steel works, glass furnaces, etc., can only wonder why the gas engineers have not previously taken up this very important matter. The concentration of the production of heat on one point, which is afforded by a producer plant, has surely great advantages in saving fuel and labor. I have hurriedly glanced over Mr. Doherty's tables and calculations and consequently, have had no

time to fully appreciate them. I would take issue with Mr. Doherty on one point only, which I think is rather in favor of the position he has taken. He says it is not advisable, in his opinion, to pre-heat the primary air because it takes the sensible heat producer gas as an absolute loss. I would call attention to the fact that the products of combustion contain a very much larger quantity of heat than the secondary air could absorb. It appears to me that the primary air can successfully be pre-heated, which would result in a higher temperature in the producer for the process of gasifying fuel. This would result in a much better producer gas, containing a larger percentage of hydrogen and carbon-monoxide. The consequence would be a loss of heat in the off-gases on account of the reduced volume of gas burned under the retorts. Mr. Doherty also states that the pre-heating of the primary air would not be practicable, as the temperature of the producer must be kept below the fusing point of ash. This position is hardly correct because it may be possible, as is done in a great many other instances (for example, in blast furnaces, cupolas, etc.) to take out the clinker in a liquid state as slag, by which a considerable reduction of labor may be obtained; in other words, the producer can be arranged, if run at a sufficiently high temperature, *i. e.*, with air sufficiently pre-heated to tap off liquid slag as is done in blast furnaces, etc.

Mr. Young:—Mr. President, I heartily agree with Mr. Doherty. There is a greater field for saving in our fuel under benches by the use of the producer than in any other way, with the isolated producers. In Halifax we had a producer for firing our ovens. It was a very elaborate affair. Probably some of you are familiar with the construction of it for the recovery of the sulphate of ammonia. In certain localities and with certain coal you can recover from 80 to 100 pounds of the sulphate of ammonia per ton of coal by this method, and in that way your fuel would cost you absolutely nothing, and with gas produced, can so regulate your heats under your benches that your wear and tear is reduced to a minimum as well as cost, but even with the producers used in steel plants, glass works, etc., I think they get very much better results than they do with the producer under the bench because it is under more absolute control. Your gas is always practically the same. You have an opportunity of making an analysis and determining what your gas is, and get your producer in condition so you can get the results which you desire.

MR. DOHERTY:—Dr. Schniewind did not quite grasp my reference to pre-heating the primary air. The point he made was right if my position had been what he thought it was. I was talking about the doubtful advantage of pre-heating the primary air for our present benches. The only reason I did not advocate pre-heating the air for the producer is from the fact that if you are using soft coal you have rather an ugly proposition to recover your heat. His point is very well taken. If you are using coke you will get a direct gas that will not deposit tar or anything of that sort on your recuperator flues or your regenerator checker work. I find no trouble where producers are properly run, in avoiding any serious difficulty from clinkering. I might say there will be absolutely none, if properly run, because they do not have to run at a temperature above the fusing point of ash. This discussion is simply a contribution to try and re-open this subject for the consideration of gas engineers. I believe it is an important one in gas economics, and I hope that some man will take exception to what I have said and try and prove that I am wrong, and then we will get at it again. In Mr. Russell's paper I want to call attention to one point, and that is the fact that when he gives his gas per 1,000 cubic feet and includes the benches only, it is unfair. He ought to include real estate, buildings, and everything else, and if he will figure up buildings, real estate and all the expenses incident to a complete retort house, he will find that his benches of 9's will run very much less than any other sort of bench. I know that Mr. Russell is an advocate of benches of 9's, and I guess he did not want to make it look too bad.

MR. RUSSELL:—I agree with you, but as I stated in my answer to a question, local conditions govern largely the retort-house construction, and it would be such an exhaustive work to go into all these details as to the cost of constructing retort-houses, cost of real estate, etc., that it would be very hard to arrive at any accurate figure. Your real estate would be apt to vary. It certainly would vary in value enormously, wherever you located your works. In some instances it would be very slight, and in others it would be very, very great; and also the surrounding lay of the land. All of those things, I do not think you would be able to figure out accurately so as to get at any comprehensive rule to cover the installation of retort house and equipment of retort and carrying in of coal, handling machinery, etc. You could carry it on indefinitely without getting any comprehensive result, so that I limited it entirely to the benches.

Mr. Doherty:—Dr. Schniewind computes ammonia in sulphate, and apparently Mr. Young does. I think it has been customary, or it has been growing more and more customary in the gas fraternity for the last four or five years, to always compute ammonia in pounds of ammonia gas; and to have one man stating the quantities of ammonia in sulphate and another in ammonia gas is often confusing. I think the gas men ought to aim to try and get some standard method in the use of certain standards of value. And I think pounds of ammonia gas, even though you are making sulphate of ammonia, is the better way of stating it.

Dr. Schniewind:—I believe the figures for the price for any product should be determined by the form in which it is brought on the market, at least to a large extent. At present the largest quantity of ammonia in this country is turned out in the form of concentrated liquor, but soon the manufacture of ammonia in the form of sulphate will predominate. Why not adopt the basis in fixing the price that is adopted all the world over, and that is sulphate of ammonia?

Mr. Doherty:—Because the other is an improvement. Most of the gas companies of this country sell concentrated ammonia.

Dr. Schniewind:—Sulphate of ammonia contains 25 per cent. of ammonia. Consequently, the price of ammonia per pound can be easily calculated by multiplying the price of a pound of the sulphate of ammonia by four. This is a very simple process, and all the market quotations are given for ammonia in the form of sulphate of ammonia.

Mr. Doherty:—What I thought we should do is to adopt some uniform method in stating our production of ammonia. Now, it happens without any formal action on it, that it has been customary for gas men to consider it as pounds of free ammonia. If the other method is better, we ought some day or another to formally adopt it. The only point I wanted to call attention to is the lack of uniformity. It is a good deal like stating in ounce-gallons when percentage is always better, I think.

It was then moved, seconded and carried that the Association adjourn until 2 P. M. of the same day.

SECOND DAY.—AFTERNOON SESSION.

The Association met at 2 P. M.

PRESIDENT DOHERTY:—The next order of business this afternoon will be the

QUESTION BOX.

Question 1. Does a gas consumer at whose house the street-main pressure is 4 inches get more or less heat units or lighting value for his dollar than does a consumer at whose house the pressure is 2 inches, and why?

MR. DUNBAR:—I should say that the man who gets his gas at a pressure of 4 inches gets more for his money than when his pressure is at 2 inches, because the gas is compressed to that extent the more, but it is so small that it is hardly worth considering.

PRESIDENT DOHERTY:—Do you see any other advantage of the higher pressure, Mr. Dunbar?

MR. DUNBAR:—Well, another advantage is that if he gets that at his burner, by a Welsbach lamp by reason of a more intimate connection with the greater pressure, you would get more candle-power by reason of the increased heat.

PRESIDENT DOHERTY:—That is right. If he had a higher pressure by operation in an incandescent gas burner or any Bunsen burner you can get a more intimate mixture and, therefore, a higher flame temperature, although the quantity of heat is not increased.

Question 2. What effect does water-gas as compared with coal-gas have on the life of a meter?

G. M. WITHERDEN:—I would say, in general, that there is practically no differnce.

PRESIDENT DOHERTY:—I do not agree with you. I think, in general, that the life of a meter is longer with coal-gas than water-gas, but I do not know why.

Question 3. What is the cost of operating a rotary scrubber having a capacity of 500,000 cubic feet per day?

MR. MOSES:—It would require about six-horse-power to run a rotary scrubber of that capacity. We are using one that has about that size engine to run it.

PRESIDENT DOHERTY:—I think your estimate is too high. As a rule, I do not think it will take that much. About three I would say.

Question 5. What is the comparative cost of gas and gasoline when used in a gas engine?

MR. LATHROP:—It seems to me that would wholly depend upon the price of gas per 1,000 and the price of gasoline per gallon.

PRESIDENT DOHERTY:—I would answer that question by saying it would be about equal to the comparative heating value of gas and gasoline, and that it would take 230 feet of coal-gas to equal a gallon of gasoline.

Question 9. What material has proven most satisfactory for coal-shed floors?

MR. BAXTER:—I have in my time used the concrete and asphaltum, and I have also used tar pavements. Tar pavements I like very much. I have used plank and brick, but I found that they were very hard on the shovel—the edge of the shovel—and hard on the man shoveling. I prefer the tarred pavements to anything I have used, if properly mixed.

PRESIDENT DOHERTY:—What is the next best flooring?

MR. BAXTER:—Concrete. I have tried wooden floors made of pine plank, but they turned up at the ends and warped and twisted. It was hard for the man in drawing out the coal wagons, owing to the plank being warped and twisted, but with a smooth pavement made of tar or concrete it is much easier for a man to pull the wagon along and much easier to shovel coal on. The trouble with concrete, where there are heavy wagons used, is that it is apt to become crushed and full of holes. It is not as durable. A concrete floor will break up worse than a tarred floor. Coal dropping some distance is very apt to break the concrete. I prefer a tarred pavement to anything else.

MR. LATHROP:—Does the tarred pavement make as satisfactory a floor for teams to drive over or does it cut up and wear fast?

MR. BAXTER:—No; it doesn't cut away. The only result is the dent or impression that the wheels would naturally make, and that was very slight.

Question 10. What are the best results obtained as to the consumption of gas per hour with a four-burner gas arc, giving maximum light?

Mr. Andrews:—I think the best results usually obtained with a four-burner gas arc, open chimney type, are approximately 25 feet an hour. This also holds true in regard to chimney burners, allowing for the usual amount used for the by-pass. If a man asked me how much an arc burner will use per hour, I would tell him 25 feet an hour, which covers enough for by-pass used during the remainder of the night and during the daytime. An ordinary Welsbach burner will not consume much over 4 feet at the outside. Our experience has been principally with the Welsbach burner and the Manhattan lamp. I have not tested other lamps as to consumption.

Mr. Franklin:—I may say that an ordinary Welsbach cluster lamp would average about 3½ feet per burner under 3 1/5 inches pressure. Without the cluster they vary all the way from 5 to 6 feet per burner under 3½ inches pressure when the mantle is full of flame, because you have not the draft in a burner except that which you would have in one with a chimney, and that makes a difference.

Question 11. What is the best way to clean out a gas main half full of slush?

Mr. Franklin:—I happened to have a main pretty well filled with slush, and I flushed it out with water.

Question 13. What success are gas companies having with the gas arc lamps, and how is the best way to introduce them?

Mr. Mulholland:—I will give you our experience. We have put out since January 1, probably 150 of the Kalamazoo lamps. I suppose that is what is referred to, and in no instance have we gone to anyone to ask them to purchase the lamp or rent the lamp. We have gone to places where they were burning electric lights exclusively, letting the gas consumer severely alone, and have asked these people to let us put in a few of our gas arc lamps to use for 30 or 60 days, and at the expiration of that time to be taken out if they found the lamp was not a success, or they found the bill was not satisfactory or sufficiently low to justify them either in renting or purchasing the lamp. With an experience of 150 lamps placed in this way we have yet to find a single customer who has come to us and said, take out the lamp. They have all proven to be satisfactory. We gave them the privilege of taking the lamp at an increase of $1 over what we actually paid for it, or to pay us 75 cents per month rental, which included all maintenance. No matter which way they take it we send

around periodically and clean the globes and keep them in condition. We have now no lamps out at rental. They have all been purchased, and we have sold about 150 lamps. Of course we have displaced principally electric arc lamps and a good many incandescent lamps have also come out. Our experience has been very gratifying, and we expect to continue it. The charge of 75 cents per month is for the rental of the lamp and cleaning the globes and for maintenance. That is, whether we rent them or sell them outright, we charge them so much for actual repairs that are put on, and nothing for cleaning or anything else.

MR. LITTLEHALES:—I would like to ask the last speaker, Mr. President, in case an existing gas consumer asks for them, will you supply them?

MR. MULHOLLAND:—Certainly. If a man is a satisfactory gas consumer, however, we do not bother him, but we are after the other fellow now who has been using electric light.

MR. FRANKLIN:—During the year 1900 we placed something like 1,600 lamps throughout Cincinnati on a years trial, keeping them in condition, furnishing the mantles, etc. At the end of that time we sent out the bills for the lamps, and I am glad to say that we had only 55 of them come back. It is our intention this year to put them out at $1 per month, and at the end of the year the lamp belongs to the consumer.

Question 16. Is it better, all things considered, to run a water-gas generator at a high temperature, producing a little lamp-black and a small amount of tar, but sending some tar over with the gas, and extracting it by special apparatus, or is it better to run the apparatus at a lower temperature, making no lamp-black at all, getting a smaller yield of gas per gallon of oil, but sending no tar over with the gas?

THE PREISDENT:—That fellow has asked a conundrum. I think he means "sending more tar over with the gas." Is the man here who asked that question? Can anybody answer the question? If nobody volunteers an answer we will pass it for the present.

The next order of exercise, gentlemen, will be the reports of committees, which we carried over from yesterday. The advertising committee will make their report first, and as I am the representative of the Ohio Gas Light Association on this committee, I will take the liberty of reading the report.

REPORT OF COMMITTEE NATIONAL ADVERTISING BUREAU.

To the Members of the Ohio Gas Light Association:

GENTLEMEN:—The members of this committee have been so situated that it has never been possible to get a full meeting of the committee. Work has been done entirely by correspondence, and delay has been mostly occasioned by the inability of the representative of this Association to meet with the other members.

Very little support has been given to the plan except by a few gas companies, although many converts have been made, and especially during the last six months.

About 40 per cent. of the prominent gas men look on the scheme with favor, but are only willing to subscribe provided all gas companies subscribe, and this is as yet impossible. The committee have raised more or less funds among themselves to take care of the work already done and work planned.

We did not present our report yesterday as the committee had not reached an agreement of what plans should be followed, and to our regret we are not yet in accord.

If the original plans of advertising in the high-class journals fail, the committee will either make arrangements to purchase and send direct to non-fuel gas users one of the high-class journals in which all of our advertising will be carried, or else we will publish a high-class journal for such distribution (similar to the *Ladies' Home Journal*) under the direction of the committee. These two alternative plans are being considered to overcome our greatest obstacle, *viz.*, the equitable division of expenses among gas companies according to the benefit derived. We also anticipate reproducing all good gas advertisements for general distribution.

Outside of the report, I will say that we took this matter up two years ago at our meeting. We had to wait for the meeting of the Western and the meeting of the American. Immediately after the meeting of the American I was stationed at Denver and I was never able to leave Denver for many, many months after that, and have had very little time on my hands until the last two or three weeks. I have been very much crowded for time. Orally, I may report that I took ten men selected as representative gas men; two of them were absolutely against the scheme and eight of them ended by saying that they would go into it if all gas companies subscribed, but they would not be one of a portion of

the gas companies to subscribe, and unless some means could be devised to get all the gas companies in they would not subscribe or help to move it along.

We have already arranged to subscribe to a press clipping bureau to get the advertisements of other gas companies, and then if we can raise a fund we will reproduce them and send them around to the gas companies. That is all we have to report now. The committee is not as yet unanimous as to the course to pursue. There is no permanent disagreement. It is simply that we have not had the proper time for consultation and consideration of some matters which we have had to take up.

Respectfully submitted, HENRY L. DOHERTY.

MR. STONE:—I move that the report be received, placed on file and the committee continued. (Seconded and adopted.)

PRESIDENT DOHERTY:—Mr. Eysenbach, the Editor of the Wrinkle Department, has another wrinkle which he will read to us at this time, contributed by B. E. Chollar, of St. Louis, Mo.

MR. EYSENBACH:—I will say that this wrinkle was received too late to be incorporated in the Wrinkle Department as printed.

B. E. Chollar's wrinkle was then read as follows:

WRINKLES.

DEVICE FOR DISTRIBUTING WATER IN TOWER SCRUBBERS.

The object of this device is to distribute water at such intervals and in such quantities in tower scrubbers as is desired.

The apparatus consists of a small safety valve, or pressure regulator, such as is used on a small boiler, and the small tin or wooden receptacles, A, B and C, shown in the accompanying sketch.

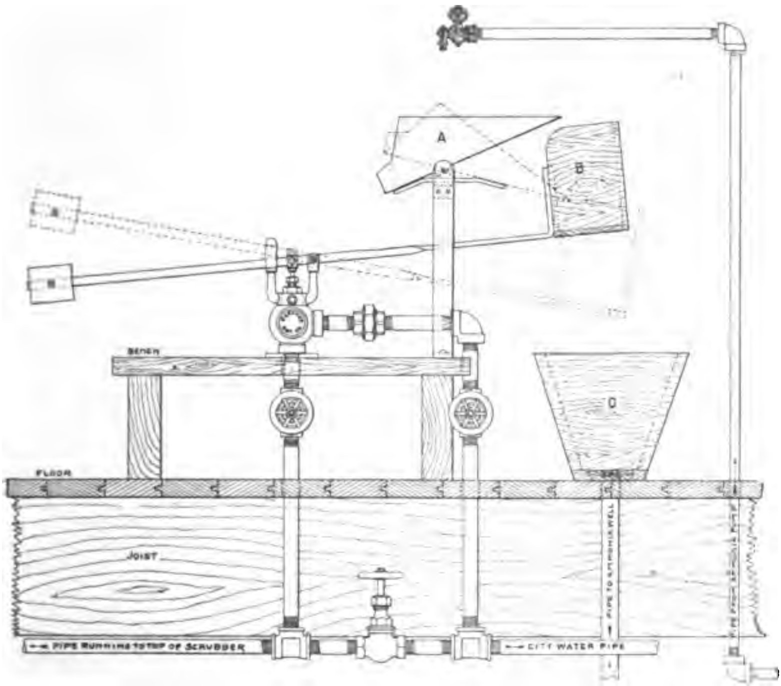
There is no change in the mechanism of the valve except the lengthening of the lever to carry the small box, B.

The valve can be connected anywhere in any convenient place in the line of pipe from the water main to top of the scrubber, with the necessary valves and fittings to effect a by-pass. The by-pass is really a necessity, for the scrubber should be furnished with water when the valve is in need of repair.

In the operation of the apparatus it is necessary to have the supply pipe with L burner cock attached, furnished with water

under a nearly constant pressure. This can be obtained by connecting it to the outlet pipe of a pump connecting two ammonia wells.

Water from the supply pipe is admitted into the receptacle, A, which is large enough to hold about a quart and a half of water. This receptacle is so balanced that when it is filled to the overflowing point the discharging end becomes so heavy that it overbalances, throwing its contents of water into B, and falling back into its first position. The impulse which the water has received together with its weight overcomes the counter-weight on the other end of the lever, forcing B down to the position indicated by dotted lines, gradually opening the valve and supplying the scrubber with fresh water.



NO. XXIII. AUTOMATIC WATER DISTRIBUTER FOR TOWER SCRUBBERS.

The water runs from B through a small-sized opening it has in the bottom into C, which is nothing more than a catch basin with a pipe running to the ammonia well. As the water runs

from B, B's weight becomes less and the counter-weight draws it back into its first position which closes the valve. When A is again filled it discharges into B, as described.

The intervals of time between the discharge of A can be controlled by means of the L burner cock on the supply pipe, thus controlling the frequency of the openings of the valve and the water supplied to the scrubber.

Where there are two or more scrubbers one set of this apparatus can be used for each scrubber, the first passing fresh water and the second, with the aid of a pump, passing liquor from the first scrubber.

The different pieces of the apparatus should be connected and placed with reference to each other as they are shown on the sketch.

PRESIDENT DOHRETY:—The next thing we will hear is the report of the Specific Gravity Committee.

J. D. SHATTUCK, of Darby, Pa., then presented the following:

REPORT OF SPECIFIC GRAVITY COMMITTEE.

To the Ohio Gas Light Association:

MR. PRESIDENT AND GENTLEMEN:—Our report is not one based upon any particular gas, but rather on the average gas, and this information therefore is for practical purposes only, it being understood that each gas has a specific gravity according to its actual analysis. The practical results for

Coal-gas range between 0.420 and 4.450.
Coke-oven gas, between 0.520 and 0.550.
Water-gas, between 0.600 and 0.680.
Natural gas, between 0.550 and 0.600.

Respectfully submitted,

J. D. SHATTUCK,
JAMES W. DUNBAR,
GEORGE WHYSALL,
ERNEST E. EYSENBACH,
Committee.

THE PRESIDENT:—I will next call for the report of the Committee on Next Place of Meeting.

REPORT OF THE COMMITTEE ON NEXT PLACE OF MEETING.

To the Ohio Gas Light Association:

GENTLEMEN:—In making the report of this committee I want to say that we have approached several members of the Association in regard to the place of next meeting, and it seems to be the unanimous opinion that Cincinnati should be the place of meeting of this Association for the year 1903.

Respectfully submitted,

JOHN FRANKLIN, *Chairman.*

PRESIDENT DOHERTY:—Is Cincinnati big enough to take care of a convention of this size? You know we are growing.

MR. FRANKLIN:—I think so. I want to say we will do all in our power to make your visit to that city a pleasant one, and I trust you will all be there. It is the unanimous report of the committee that Cincinnati be the next place of meeting.

On motion, duly seconded and carried, the report of the committee was unanimously adopted.

PRESIDENT DOHERTY:—The next order of business will be the report of the Committee on President's Address.

MR. LATHROP then submitted the following:

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

To the Ohio Gas Light Association:

GENTLEMEN:—The committee to which was referred the address of Henry L. Doherty, President of the Ohio Gas Light Association, has very carefully considered the address. It is an able presentation of the most important issues now before the gas industry in the United States. We congratulate the President upon the originality of many of his suggestions, and which are brought forth in consequence of his deep feeling and earnest interest in the welfare of the gas profession.

We consider that the arrangement for the order of this meeting has been most happy by dividing the papers into two classes—one relating to the commercial aspect and the other to the engineering features of the industry. Each portion is made more coherent, as well as time being saved.

The general recommendations of the President are timely, but the committee refers especially to a certain portion of them. We approve the recommendation that the present policy of the Association be not changed, but continue as a state organization, but

welcoming membership from other states. Also, that talent which will contribute to the benefit of the gas fraternity be called upon, wherever available, for contributions.

The suggestions by the President relating to gas appliances should bear fruit. If gas appliances can be rendered more efficient, it would be equivalent to reducing the price of gas; and, as a step toward securing greater efficiency, we recommend that a committee of three be appointed to devise a standard method of testing gas appliances, and that such committee confer with manufacturers for co-operation.

The Ohio Association has made many contributions of value to the gas business, and if available would be of far-reaching benefit. We recommend that the officers of the Association be authorized to publish the proceedings of this meeting and be instructed to devise means for publishing the proceedings each year, and the back proceedings as rapidly as the funds they can command will permit.

It is a fact that many developments affecting the industry occur throughout the rest of the world, and of which we frequently have no knowledge. We would therefore recommend that an editor be appointed to inform the Association in a paper every year of the progress of the gas industry throughout the world in the way of new methods of manufacture, apparatus, etc.

It is a lamentable fact that but little research work has been carried on by the gas companies in the United States. Thorough research work is most important, and we recommend that the officers of the Association be authorized to appoint some one who will undertake the task.

We consider that the views of the president regarding the formation of or change of one of the Associations to an organization devoting itself to the consideration of technical subjects and problems would prove advantageous to the gas industry, and we recommend this to the earnest consideration of the gas fraternity, regardless of Association affiliations. This would possibly eventuate in the formation of a gas-engineering institute.

Respectfully submitted,

A. P. LATHROP,
JOHN D. MCILHENNY,
GEO. WHYSALL,

Committee.

It was then moved by Mr. Stone, duly seconded and carried, that the report of the Committee on President's Address be adopted.

JOHN R. LYNN then submitted the following:

REPORT OF COMMITTEE ON MEMORIALS.

To the Ohio Gas Light Association:

GENTLEMEN:—We, the committee, appointed to prepare a memorial to the deceased of the past year, would respectfully submit the following:

William Stacey, President of the Stacey Manufacturing Company, of Cincinnati, one of the old and reliable men of this fraternity, departed this life unexpectedly on June 17, 1901. Perhaps no other member of this Association was more universally respected and beloved for numerous excellent qualities than William Stacey, and no one can be more sadly missed by all. His business life was spotless, his private character without a blemish, his sociability of that sort which brought him in close contact with his fellow men. His life was like the glorious sunshine of his disposition, and his death is most deeply deplored.

Edwin H. Wehle, General Manager of the Monarch Water Heating Company, Pittsburgh, Pa., became a member of this Association March 21, 1900, and while our personal acquaintance with him was of short duration, he was highly esteemed by those who knew him, and his death is a distinct loss.

Henry C. Kirby, President of the Goff-Kirby Coal Company. Cleveland, O., was also elected to membership at the meeting of 1900. He has been well known and highly respected by many of our members during his long and honorable business career. Mr. Kirby departed this life July 21, 1901, to the great regret of the community in which he lived and the people among whom he associated in business and society. Be it

Resolved, By this Association that, whereas an Omnipotent Power has removed from our midst these, our friends and fellow-members, we express our deep appreciation of the loss we have sustained; and that it also be

Resolved, That the Secretary of this Association convey to the family and immediate friends of each of these deceased members our deepest sympathy in their great sense of bereavement, with our assurance that while absent in the flesh, these, our friends, shall not be forgotten.

Respectfully submitted,

JOHN R. LYNN,
A. J. STACEY,
Committee.

On motion of A. P. Lathrop, seconded by C. W. Andrews, the report of the Memorial Committee was unanimously adopted.

THE PRESIDENT:—We will now take up a discussion of the subject, "Can Iron Meter Connections be Used to Better Advantage Than Lead," by W. A. Baehr and E. E. Eysenbach.

W. A. Baehr's written discussion of the above subject was then read to the Association as follows:

IRON OR LEAD FOR METER CONNECTIONS.

W. A. BAEHR.

The discussion is based upon the costs for a 5-light meter connection only, as that size is the predominating one, and costs are stated as they exist in Denver. If iron connections were adopted, all new services and house risers could be so arranged as to reduce the estimates given below, which are for the average time and material required to set meters where lead connections have heretofore been used.

Our iron connections are made by simply using a long, brass swivel on the meter, with a pipe thread cut at the end, and the manufacturers furnish these without extra charge. As the distance center to center of meter screws varies slightly, even for the same makes, a sort of swinging joint is required to allow for this. We use a street ell and a common ell, but are trying at present to procure a fitting in the nature of an offset which would serve the same purpose as the two ells, and would reduce the cost somewhat.

COST OF A 5-LIGHT IRON CONNECTION IN PLACE.

Material. — Two-threaded swivels (no charge).

1¾-inch cock (service)	$0 35
5¾-inch nipples of various lengths	25
5-¾inch ells — two for offset	15
Labor setting. — Man and helper, with horse and wagon, average 15 sets per day, including delivery of meter...	30
Total cost	$1 05

COST USING LEAD CONNECTION.

Material. — Two swivels (no charge).	
¾-inch meter cock	$0 35
Two ¾-inch couplings	07
Two 12-inch pipes, ⅝ inch, 1 ft. lead pipe, 28 ounces per ft.	20
Solder, gas, etc.	02
Shop labor to make 1 pair — two men can make about 35 pair per day	17
Labor setting. — Man and helper, with horse and wagon, average 20 sets per day, including delivery of meter	23
Total cost	$1 04

In general, a nipple or two, and perhaps several fittings are required, which would bring the cost of the lead connection above that of the iron. Neither is it said that men can always make 15 sets with iron per day, as occasions will arise which will require much more labor. However, with us the cost is practically the same for either style of connection in changing meters in use.

The advantages of iron connections are as follows:

1. An iron connection once in is permanent.
2. No danger of reduced gas-way due to kinking lead pipe.
3. Less apt to have leaks.
4. Stronger than lead.
5. As men are obliged to use more care, the meters are set better.
6. Not so much danger of breakage at connections.
7. Meter brackets not necessary.
8. Theft of gas is prevented, as connections are harder to take off.
9. Better in case of fire; will not melt.
10. Where an iron connection is in, it is easier to re-set a meter.
11. In old bent lead connections naphthaline apparently deposits readily; not so with iron.
12. Can make a better connection under a low show-window, preventing the trap that almost invariably is formed with lead.
13. When freeze-up's occur, it is easier to thaw out by using gasoline torches.
14. It is suggested that rats cannot eat the iron pipe.
15. An iron connection is a more workmanlike job.

The disadvantages of iron connections are as follows:

1. Takes better fitters to set meters.

2. We are obliged to carry more material in wagon, such as fittings, nipples, etc.

3. Somewhat greater tool expense.

4. In setting, men occasionally break out the meter screws. More care is necessary. We think if iron connections were generally adopted, the meter manufacturers will set in the screws more substantially.

With the cost about the same, we prefer the iron connections, and are using them exclusively on all sizes of meters.

Ernest E. Eysenbach, of Columbus, O., then read his written contribution on the same subject, which is as follows:

IRON METER CONNECTIONS.

E. E. EYSENBACH.

The artificial gas company at Columbus has always used the lead connections, but the natural gas company has 15,000 meters connected up entirely with iron connections, and they have experienced no trouble from this whatever. I have thought for a long time that I would use only iron connections, even if slightly more expensive. I cannot give you any figures on the cost of these iron connections, as the natural gas company only put in the service to the curb line, and the plumbers do all the service work, setting, house-piping, etc.

DISCUSSION.

John Franklin:—Mr. President and gentlemen, referring to the paper just read of Mr. Baehr, regarding the advantages to be gained by using iron-meter connections in place of lead, will say, that I personlly cannot agree with him on that point, as I do not consider it practical for the following reasons:

First.—It would require the most experienced and practical fitters to connect meters with iron-pipe connections by reason of the necessity of most exacting and accurate fitting, in order that there would be *no strain* upon meter tubes. This labor will naturally cost higher than ordinary, thereby increasing the cost of installation.

Second.—It would be necessary to use ties, ells and nipples in making connections, thereby forming the very foundation for the deposit of naphthaline and other obstructing material, consequently adding to in place of diminishing the obstructive points which form the basis of complaints, and which prove at times an expense feature in the gas business, when you consider the annoyance to consumer, decrease in sale of gas and expense of rectification.

Third.—To insure the best mechanical fitting, saving of time and labor, it would necessitate at all times, providing, of course, you are setting a great number of meters, the need of horse, wagon and helper, to carry sufficient material, such as fittings and assorted nipples of different lengths and sizes, to enable you to complete mechanically the satisfactory setting of meters.

Fourth.—If the work of connecting was a permanent one, I might consider the adoption more favorable, but at times it is necessary to disconnect in order to clean our connections, to change meters, for tests, leaks or larger meters, which would mean, in case of the latter, an entire remodeling of connections by reason of the variation in size of meters, adds materially to the cost of installation of meter connections.

Fifth.—In the connecting up of meters with iron-pipe connections, it would be impracticable to use a meter box if permanently fastened, for, if it was found necessary to disconnect, it would prove a problem to remove the meter without a strain upon it. If, on the other hand, you suspend your meter, without support or protection of any kind you are assuming considerable risk, as the least jolt or jar is liable to spring a leak in your meter, thereby jeopardizing life and property, and also rendering the company liable to damages.

Necessity being "the mother of invention" came vividly to my mind some three years ago, while making an investigation in the store-room of the campany, where I found about three tons of scrap lead which had formerly served as meter connections. To say I was surprised would be drawing it mildly. I was astounded with the exhibit, and, realizing the necessity for prompt action, at once cast about for some remedy to alleviate the existing conditions. It, therefore, gives me pleasure to present to your notice this lead connection, the merits of which I will explain as follows:

First.—It is practically impossible to crush, bend or kink the lead while fitting to suit condition, unless done maliciously or by

ignorance, as a boy with any degree of intelligence can place them in connection.

Second.—Can be made to suit any and all conditions on premises and when once connected can be easily disconnected and reconnected without detriment to connection and without removing from meter.

Third.—It is perfectly pliable, having no strain upon meter, no points for the reception of obstructing material, allowing at all times perfect freedom of supply of gas to meter.

Fourth.—They are made in four sizes: 1 inch, 1¼ inch, 1½ inch and 2 inches, and arranged with various sized couplings to fit 5, 10, 20, 30, 45, 60 and 100-light meters; have metal gooseneck at meter end, this being the only solder joint.

Fifth.—Can be locked at both stopcock and meter end by means of a metallic seal, first, as a protection against tampering, but more for the necessity of knowing who the mechanic is that filled the connection, so that in case of an unsatisfactory condition being found, we have positive evidence who did the work. The punch and wrench are a combination tool and are furnished to each man doing this work; each punch is numbered so that in case of defective mechanical work the man seals his own doom by the tell tale seal.

MR. MULHOLLAND:—I have heard of some gas companies who used one iron and one lead connection in setting meters. I would like to ask whether any members here have tried that experiment, and if so what their success has been and what the results have shown.

MR. MOSES:—My experience has been that lead connections are better and cheaper. I shorten the lead pipe to about 12 or 14 inches. I make all our connections through the winter. We are making this winter about 5,000 connections in the shop and they will last us part of the summer.

VICE PRESIDENT ANDREWS resumes the chair.

H. L. DOHERTY:—The question of iron and lead-meter connections I think started in a meeting of the McMillin companies about four years ago. That was the first I heard of it. It was proposed then to use the iron-meter connections instead of the lead connections. Since then Denver has adopted the iron-meter connections and Milwaukee has adopted iron-meter connections. At the time Mr. Baehr wrote this paper we saw some of the disadvantages in iron-meter connections, to which he has called your attention. We

have now concluded that there are no disadvantagss in iron-meter connections. The advantages are all in their favor and we do not want any lead. The next thing I want to see is a cast-iron meter. If every gas company had started in to use iron-meter connections from the beginning, there is no question in the world but what they would have saved very, very much money. They would have more consumption than they have now. In making these lead connections you have to depend upon men whose work you cannot supervise. You can hardly inspect every job they do, or at least gas companies do not do it. They cannot kink iron-meter connections. We can make an iron-meter connection so that it will do for a 3, a 5, or a 10-light meter. That is what they are doing in Milwaukee. They use an offset fitting and just swing the fitting around on one side or the other. We have concluded now that we could not only manufacture them cheaper with the lead, but we can take care of the work in the houses cheaper than with lead. It took our men a little while to learn how to get on to the proper use of iron-meter connections, but we think they are very much better than lead connections. I came very nearly catching Mr. Moses. He was about to tell us how he set 10,000 meters in six months, and he came very near saying that the 5,000 to which he referred would last a year. I went into the plant of a gas company not long ago to see the superintendent of distribution. We were visiting the distribution warehouse when I saw a man starting out with a pair of lead connections; I said, "Why don't you use iron connections? I think they are better." He said, "Oh, no, no—they are not better." I said, "I think so. I have always had lots of trouble with lead-meter connections kinking and leaking, and troubles of that sort." He said, "We do not have a bit of trouble." I said, "You must have some trouble." He said, "No, sir; we do not have any trouble." "Well," he said, "it is so insignificant that it doesn't amount to anything." And I dropped the conversation. I concluded it was useless to argue with him. In going around through the various buildings we finally came to a man who had a hatchet and was engaged at work on a pile of old condemned lead connections, a stack about that high (indicating), and he was picking up a connection, looking at it, and then hacking off the ends of it and throwing it into a scrap pile. He would then take up another one which he would straighten out and lay on a bench to be used again. I said, "what is that fellow doing?" My friend had forgotten himself entirely. He said, "Those are condemned lead

connections, and since I have been here I have saved this company thousands of dollars on connections I have saved that were condemned although they were really good." So that their condemnation of lead-meter connections was a great many. That is what we want to avoid. I have always had trouble with lead-meter connections. Mr. Franklin's connection may be all right, but I am not familiar with it. I do know that a lead connection is not as serviceable as an iron connection.

Mr. Franklin:—There is no question but that the old style lead-meter connection is out of date, but at the same time the construction of iron-meter connections is equally unsatisfactory when making them with hips and a nipple which is an obstruction in the pipe.

President Doherty:—It is not half as bad as a kink.

Mr. Franklin:—That is true, but at the same time if you can use a connection that has neither of these difficulties, why not do it? I have a connection, I think, which beats both iron and lead connections.

Vice President Andrews:—If there are no further remarks we will take up the next discussion, which is, "Domestic Water Heaters." I will request Mr. Doherty to read the contribution of W. B. Calkins.

W. B. Calkins' written discussion on the subject of "Domestic Water Heaters" was then read by Mr. Doherty, as follows:

DOMESTIC WATER HEATERS.

W. B. CALKINS.

By the term Domestic Water Heaters, we refer to such heaters as use gas for fuel, and are placed in connection with the ordinary kitchen boilers for the purpose of heating large or small quantities of water. If a gas company is so situated that it has to compete with a strong coal market, a good water heater, properly connected, will serve a two-fold purpose; first, of furnishing quickly and economically a large or small quantity of hot water; second, of serving to keep fuel gas in use all the year around, and if the climate is not too severe, a good water heater tends to lengthen the life of the gas range two or three months, if not keeping it in use the entire year. In order to determine the efficienecy of the different makes of water heaters, a series of tests were made by the Denver Gas and Electric Co., the details of the test being as follows:

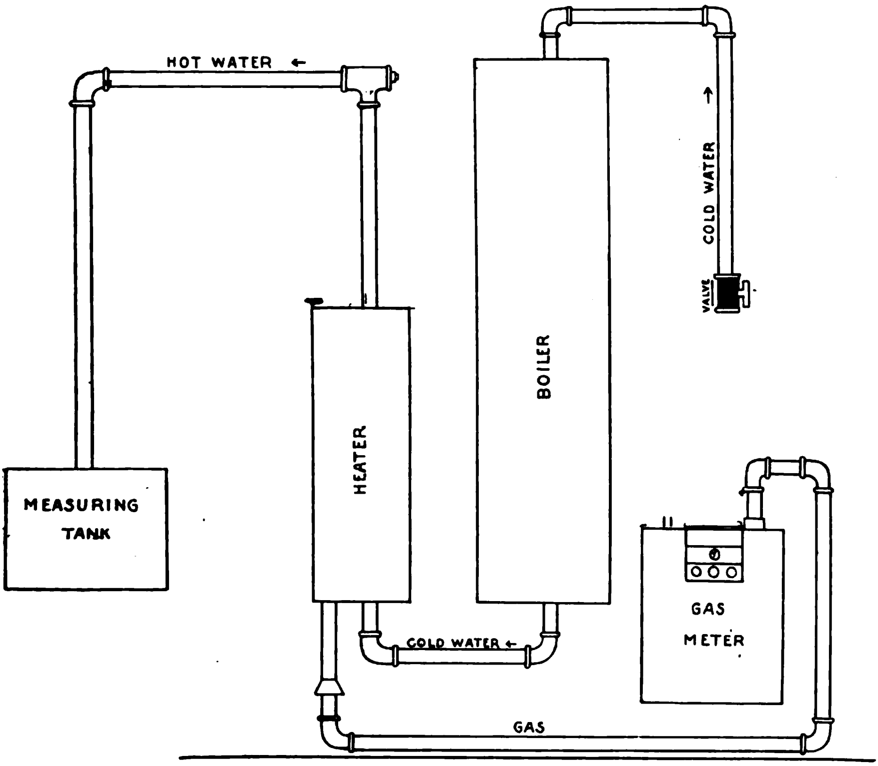
Each pressure heater was set in position, as shown in the diagram, the cold-water inlet being connected to a 30-gallon boiler, and the flow of water through the boiler and heater was regulated by a valve on the cold-water inlet to the boiler.

The hot water from the heater was not allowed to return to the boiler, but was conducted to a measuring tank through a short piece of hose.

The water used in these tests was drawn from the city mains; the temperature of in-going water was taken before each test, and found to be very constant.

In each test the temperature of hot water coming from the heater was allowed to become constant before the test was started.

The temperature of hot water was taken several times during the test to see that no variation took place.



ARRANGEMENT FOR TESTING WATER HEATERS.

The gas was passed through a portable firelight test meter, and the number of cubic feet burned was carefully noted.

In each test, five gallons or 41¾ pounds of water were passed through the heater and timed with a stop watch.

Each cubic foot of gas burned represented 540 B. T. U.'s, which number was taken as a basis of calculation in all tests.

	Inlet water	Outlet water	Cu. ft of gas used	Quan. tity of water	Time of test	Effi'c'y	Gas used per hr.	Water heated per hr.	B. T. U.'s in water
No. 1..........	52°	110°	5.8	5 gal.	10' 35"	66.6%	32.88	28.35 gal.	11824.9
No. 2..........	44°	102°	6.6	5 gal.	12' 22"	51.6%	32.01	24.25 gal.	8919.
No. 3..........	52°	112°	5.6	5 gal.	6' 42"	73.96%	50.1	44.75 gal.	19009
No. 4a.	54°	110°	5.7	5 gal.	14' 35"	66.8%	23.37	20.5 gal.	8430.
No. 4b.	54°	124°	7.2	5 gal.	16' 36"	52.0%	25.92	18.0 gal.	7278.
No. 5..........	54°	118°	6.5	5 gal.	13' 30"	58.5%	28.86	22.20 gal.	9116.8

The average gas pressure was about 1.9 inches of water.

As a great many tests were made on each heater, we will give only that one showing the greatest efficiency.

Water heaters No. 1, 2, 4 (a), 4 (b), and 5, are the ordinary small pressure water heaters; heater No. 3 is of a larger type, better adapted for barbershops or small bath houses, as it occupies too much space for the ordinary kitchen.

The efficiency in each series of tests can easily be raised by allowing a greater stream of water to flow through the heater, thus lowering the temperature, also cutting down the time in which the required quantity of water passes through the heater; this in turn, lessens the number of cubic feet of gas burned. But this rapid motion does not take place when the heater is properly connected with the boiler, as the only movement of water is that caused by the heat. This slow circulatory movement we have tried to imitate in all tests. Other tests were made in order to determine the best method of connecting the heater with the boiler, and from these tests we have deduced the following directions:

1. If possible always connect the heater to the boiler so that the base of the heater will be on a level, if not a little below the bottom of the boiler. This allows for the free circulaton of all the water in the boiler.

2. Connect the hot-water outlet from the heater to the top of the boiler. This connection answers all purposes much better than the side connection.

3. Flush cocks should be placed on the bottom connection of all heaters by which the heater, boiler and pipes can be flushed as often as needed.

4. All water heaters should be connected by a flue pipe to the chimney.

5. Cocks should be placed on the cold-water connections between the boilers and the heaters. By this arrangement any back movement of hot water can be stopped after the fire is turnd out under the heater; this prevents the heater from becoming a cooler. Other directions for the economic use of the water heaters should be prepared for the use of the people buying them, but as these will be more or less of a local nature, we will not discuss them.

F. W. Stone then read his contribution on the same subject, as follows:

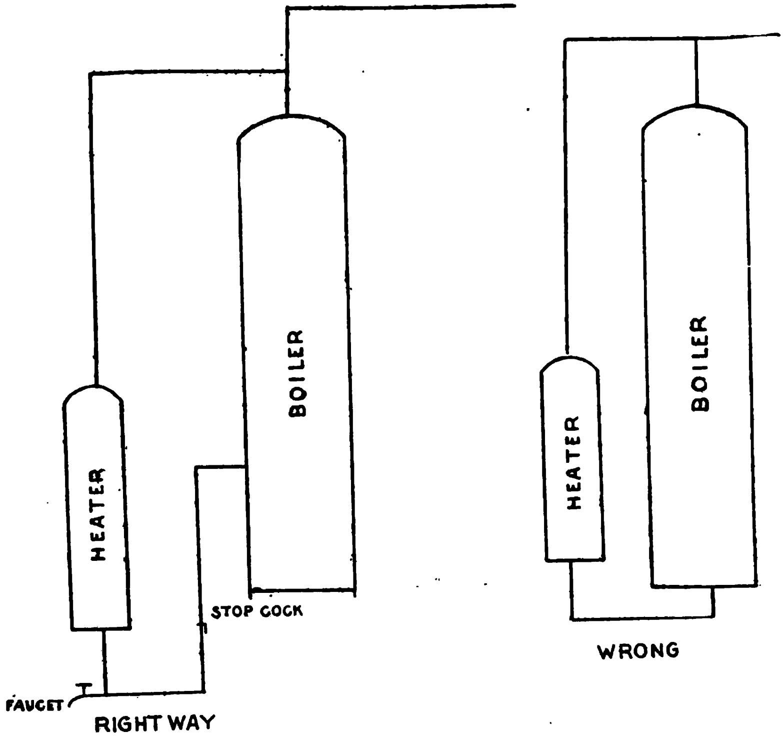
DOMESTIC WATER HEATERS.

F. W. STONE.

The paper presented by Mr. Calkins is a most interesting one, and the subject one of great importance to all sellers of gas. The tests given undoubtedly would show the efficiency of the different makes of hot-water heaters, but it would seem to me that the most practical test would have been to have connected up the heater directly to the hot-water boiler in the same manner in which it would be connected in the ordinary dwelling house, and then by means of a thermometer to have ascertained the rise in the temperature of the water in the boiler at different levels, because, as Mr. Calkins has said, the flow of water when induced simply by a rising temperature is more sluggish and quite different from that produced mechanically. The tests also seem to indicate a low efficiency. I have not the figures with me at present, but have made tests of hot-water heaters, which, burning gas having approximately 650 B. T. U.'s per cubic foot, give an efficiency from 70 to 75 per cent.

I have found more difficulty in educating plumbers to connect up domestic water heaters, than I have in determining which heater was the best, and I believe that it is just as important, even more so, to have the heater connected properly, as to have an efficient heater. In connecting up a domestic water heater, in addition to the points mentioned by Mr. Calkins, it is better to somewhat reduce the size of the pipe where it connects into the hot-water pipe at the top of the boiler, and also to be always sure to connect into the side of the tee, and not in at the end, as when you connect into the end, the flow of hot water at a faucet will sometimes draw

the cold water right through the heater, and you will hardly get any hot water at the boiler. While the circulating domestic heater must be used wherever you have the boiler connected with the water back in the range, yet, I believe that where gas alone is used



THE RIGHT AND THE WRONG WAY FOR CONNECTING WATER HEATERS

for heating hot water, the instantaneous heaters, are the most economical. The pilot light on an instantaneous heater can be adjusted so as to consume but very little gas. There is no quantity of water to keep hot all the time, and they are arranged so that the flow of water is heated as it passes through the heater.

I know of one make that will guarantee, that with artificial gas testing 700 B. T. U.'s, 1 foot of gas will heat 1 gallon of water from a temperature of 55 to 130 degrees. This would indicate an efficiency of over 89 per cent., which is much better than that indicated by the tests given by Mr. Calkins, and the outlet temperature

is also much higher. The ordinary 30-gallon hot-water boiler has 15 feet of radiating surface, and in the circulating type of domestic heaters it takes considerable gas to keep up the heat which is radiated by the hot water from this amount of surface.

DISCUSSION.

A MEMBER:—I would like to ask Mr. Stone what water heater he had reference to in his paper?

MR. STONE:—I had reference to the Monarch Water Heater. There are two or three kinds along the style of the Monarch. The quotations to which I referred in my paper are made with the authority and permission of the people manufacturing that heater. I did not wish to stand sponsor for the figures therein given, and I wrote to them asking if they would guarantee the test as indicated, and they said they would. That is all I know about it.

MR. MAXON:—In referring to these automatic water heaters I happened to know of a case not long ago where one of them blew up, occasioning a very severe explosion. It seems to me that the automatic turning on of the gas by opening of the water faucet is a rather dangerous thing.

MR. MARKS:—Which blew up, the gas or the water?

MR. MAXON:—In this instance it was the gas. The burner that ignited this heater was of the Bunsen type, and the water being turned on upstairs it opened a valve and allowed a large amount of gas to accumulate in the heater before the explosion occurred, and it simply blew the thing all to pieces. If there is no more effective way of igniting the burner in these automatic heaters than what I have seen I would consider them a dangerous appliance to install in any one's residence.

MR. MALONE:—Mr. Stone speaks of radiation from the boiler. We have a plan which we have been following out of insulating the boiler at a comparatively small cost. Two dollars will cover the cost, and we add that to the cost of the heater. We sell the independent heaters for $8 or $10, and $2 additional for insulating the boiler. The insulating material is made by a firm in Milwaukee. The thickness is about ¾ of an inch; the top of the tank is covered with cement. We have made some tests in Madison and find that we can run the water to 130 degrees, and hold it so that it does not drop below something like 72 degrees I think in 26 hours, without using any gas in the meantime.

Mr. Doherty:—I want to get after Mr. Stone. In the first place Mr. Stone's criticism on Mr. Calkins' method is a very natural one, but if he will stop to think for a minute, there will be no way of comparing the instantaneous water heater he speaks of and the pressure water heater if you connect one up to the boiler and connect the other direct to the faucet. In other words the rate of flow through the heater influences its efficiency. By connecting them up as you have connected up the instantaneous heater you can get a comparison between the pressure heater and the instantaneous heater. Then you can determine the efficiency of your pressure heater for any flow of water through it and determine any flow of water. Then when you get these efficiencies worked out you connect up on your boiler and find out what the difference of temperature is. Then you know at what rate you are running that heater. It is impossible to measure the amount of heat you have put into your boiler without having some means of circulating water in there, and even then, well, it would not make any difference whether it went back through the heater, but you cannot accurately measure the temperature of the water in that boiler unless you heat the whole boiler, so we selected this method as promising the most accurate results. Mr. Stone has said that Mr. Calkins' results seem to indicate a low efficiency. None of these tests gave anything like the effieciency when they were first brought to us. The average efficiency, just as we slipped them on and tested them, connecting them up to a boiler to get the natural difference of temperature between the top and bottom, gave us an average efficiency of 30 per cent.—78 per cent. would be easily obtainable. An efficiency of 39 per cent. in these heaters would be equivalent to selling gas at $2 per 1,000. If we are selling gas at $1 per 1,000, when it is only doing one-half as well as it should, it is equivalent to charging $2 per 1,000 for gas. So this efficiency Mr. Calkins' gave here was the highest efficiency we could get in operating a heater as connected up to a circulating boiler, but not the highest efficiency we could get when passing an immense quantity of water through them. Now Mr. Stone says "in connecting up an automatic water heater, in addition to the points mentioned by Mr. Calkins, it is better to somewhat reduce the size of the pipe where it connects into the hot-water pipe at the top of the boiler." Any reduction you make in the pipe going from the bottom of the boiler to the heater and up to the top of the boiler again, if it retards circulation in the slightest degree diminishes the efficiency

of your heater. So what we try to do is to connect up with a large-sized pipe and give it the freest possible circulation. With the Monarch instantaneous water heater at Denver we got nothing like 89 per cent., and we got an efficiency under certain conditions so low that we concluded we could not afford to recommend it to our customers. Now Mr. Stone shows the right way and the wrong way to connect up heaters. I do not see any possible advantage in connecting up a heater in the way he calls the right way as far as it affects economy. The only possible advantage I can see in that scheme of his is that your deposit is more apt to lodge in the boiler than it is to lodge in the heater. Otherwise I think it is a disadvantage because it would tend to retard circulation to a certain degree.

Now he has figured on gas here at 700 B. T. U. I do not think, ordinarily, we get gas as high in calorific value as that. Our gas at Denver, as near as I can come to it, is 540 B. T. U., mostly coal-gas or about 20 per cent. water-gas. That is due to the fact that our barometer is one-fifth lower than your barometer is here. In most of the heaters we put out now we insulate the boilers, and we find it results in a great saving.

MR. DUNBAR:—What insulating material do you use?

MR. DOHERTY:—We use a covering which is made by some Western concern. I do not know the name of it, but it is made I think of abestos, and it looks like this fluted paper they do your bottle of whisky up in when you go to the club, and then a plain sheet on each side.

VICE PRESIDENT ANDREWS:—Would you like to reply to his criticism, Mr. Stone?

MR. STONE:—I do not feel competent to argue with Mr. Doherty, and I would not have the courage to do so now did I not understand the fact that there are times that Mr. Doherty will even take the wrong side of a question for the sake of argument. Of course, everybody understands that we may differ, and we may differ honestly about the matter. I still do not think that the method of testing a heater—that is, a circulating hot-water heater, as suggested by him and by Mr. Calkins—is the best method. I base my belief on this: When you are testing a heater such as should be placed in a dwelling house, you should test it as nearly as possible under the conditions in which it would operate. Simply a theoretical test is not sufficient. You may test it practically, so that you can demonstrate its practical efficiency and its practical

utility, because you may take a heater and put it in the shop and test it and it will give you a certain precentage efficiency, and take the same heater and let an ordinary mechanic install it and then test it and you will find it will not come up to the record or percentage it tested in the shop at all. All kinds of gas apparatus are subject to the same variation. You can induce a mechanical flow of water through the heater, divide it into finer streams, make it pass corners and go around through small passages and through the small chambers of the heater, and you can get a higher efficiency through a heater in that way than you could with just simply the natural flow of the water through it. I have never tested an instantaneous heater as against a circulating heater, but I believe if I were going to do so I would take a 30-gallon tank and connect it to a circulating heater, and I would see how much gas it took to raise that 30 gallons up to a given temperature, for instance 130 degrees, and leave it at that, and then whenever the temperature in the tank reached 130 degrees I would say that that heater would give me 30 gallons of hot water at 130 degrees, because if one wanted to take a bath and wanted 30 gallons of hot water for the purpose that is just the quanity of gas I would have to use to get it under those circumstances. Then I would take an instantaneous hot-water heater and run through 30 gallons and see how much gas the instantaneous heater used. I think the comparison that way would probably be better than the way I suggested. Now, in regard to connecting the hot-water heater, I would say this, that the reason the heater was connected in the way shown, in the side of the boiler in place of at the bottom, was simply to decrease the amount of water that you would heat or that you would keep hot. If you were going to heat the whole boiler, it would come up about one-third way of the boiler, and the consequence would be that the water above that would get hotter more quickly. You would get an amount of hot water quicker that way than the other, for the same reason as suggested by Mr. Doherty that by decreasing the size of the opening at the top you would decrease the efficiency of the heater; yet, if you wanted hot water quickly, I think that would be the best way to secure it. In the case of hot-water heaters, you usually want hot water quickly, and when you want hot water quickly you can get hot water quickly by decreasing the opening at the top. That was the reason for doing it. The decrease in the size of the opening decreases the efficiency of the heater so far as the gas is concerned, but by doing

that you get hot water quicker, and that was the reason for doing it. Another reason is this: For some reason—I do not attempt to explain it—a heater set in that way gives you a better circulation than when it is set nearly level.

President Doherty:—I will answer Mr. Stone by saying that I think he slightly misunderstood us. Now we had to get a means of comparing between the instantaneous heater he speaks of and the pressure heater. You have apparently overlooked the fact that your instantaneous heater will have a different efficiency at any different flow of water. If you turn the cock on just a little way it would have a low efficiency. If you turn the cock on more it will have a higher efficiency and it will gradually ascend. The more water you put through the heater the more heat of combustion it will absorb. We wanted to get a basis whereby we could compare these two heaters. We think it is impossible to make a test on a circulating heater for the quantity of heat put in the boiler and get it accurately, because you can have your water 190 degrees at the top of the boiler and at the bottom it may be 60 degrees. Therefore, you have to calculate it section by section, or else you must churn it all up, and then you introduce a difference of temperature between the inlet and outlet of your heater. Now the efficincy of your heater will vary with the difference in the temperature between the inlet and the outlet of the heater. That is, the more you raise the temperature between the inlet side and the outlet side the lower will be the efficiency of your heater. I think it is practically impossible to test by the method you refer to, and I think if you try you will find it so. On the other hand, let us take a certain difference of temperature, say 45 degrees, 40 degrees or 30 degrees, etc. Connect up to the circulating boiler and find what the natural difference in temperature is. Then we know that when we get that given difference in temperature, say, 50 degrees, that that heater has an efficiency of 52 per cent. As you retard the circulation of your water through your heater the temperature of the water going into the boiler will be higher, but it will have absorbed less heat from the heater, and therefore the efficiency is lower. There is a difference between higher temperature and quantity of heat. If the heater is lowered you will get a higher column of heated water, and the higher this column is the more rapid will be the circulation, and the more rapid circulation the less difference in temptrature there will be in passing through the heater; and the less difference in temperature the

higher will be the efficiency, but I see no reason why one cannot drop the heater just as low with either connection. Now, by Mr. Stone's method, if you want to get a boiler full of hot water you cannot get it.

President Doherty, resuming the chair, said: Gentlemen, we have but one discussion left now, namely, "Recent Developments in Inclined Retorts," by Frederick Egner and A. H. Barrett. Mr. Egner thought he could not be at the convention, but we told him we would like to have his contribution anyhow.

Frederick Egner's written discussion was then read by Mr. Andrews as follows:

RECENT DEVELOPMENTS IN INCLINED RETORTS.

FREDERICK EGNER.

Having been honored by you with an invitation to aid in discussing the above subject, my aim shall be—as desired—to be as "concise as possible," and yet give the subject somewhat comprehensive treatment. Doubtless you all have kept up with the subject, one of such importance in the economical production of coal-gas. May I then for a few moments ask your patient consideration of the earlier history of the inclined retort in this country? It will, no doubt, clear the way in answering the pertinent question, "If the inclined retort system is all that its advocates have claimed for it, why has it not been more generally adopted in this country?" It is but about 14 years ago when the first bench of inclined retorts was erected and successfully operated for over two consecutive years at the works of the then "St. Louis Gas Company," at St. Louis, Mo. It was a single bench of 5's "D" shaped retorts, and fired by an ordinary ground floor furnace.

The results were such that the president and the engineer of that company were well satisfied with it; and this led subsequently to the erection of a stack of eight benches of seven retorts each, at what had in the meantime become the Laclede Gas Light Company, of St. Louis, Station "B." These were a failure; and to that failure may be ascribed, in my opinion, all the hesitancy by American gas men to adopt that now well authenticated successful system. There were several other failures of the inclined system about the same time. At Springfield, Mo., at Washington, D. C., and notably at the Kensal Green Station of the London Gas Light and Coke Company, at London, England, where an installa-

tion of over 450 retorts was abandoned for similar reasons as was that at the Laclede; as the chief engineer then and now, Mr. Trewby, himself told me some years later. The causes of failure were almost immediately known, and in foreign countries, remedied, and the work resumed; but with us it was different, as you all know. The causes of that failure includes some which may be well to remember now to guard against falling into a like error. We did not, for instance, take measures to prevent retorts slipping forward into the fire-room. We discussed the possibility of it, but "as they did not do it in France," we let it go at that; and the retorts slipped, and in slipping, destroyed the recuperators of the benches; pulled away from the upper mouthpieces; got badly cracked and so forth. The cracks were stopped the same as one would stop cracks in any horizontal retort and just as effectively; the destruction of the recuperators did not affect the operation of the benches to a prohibitive extent, and the slipping stopped of its own accord. But the sad mistake we made was, that we tried to introduce other fancied improvements of our own; and at last some miscreant placed an explosive under the exhauster, blew a hole into it, and thus our trial with the incline was stopped. It was the last incident which may have induced their (the benches) being torn out at last and replaced by several good sets of water-gas apparatus. I do not know if that was the case, but do know that our President had determined to spend no more money on the inclined retorts; and he being, as I gladly testify he was, an able gas engineer and generally highly esteemed that put an end to inclined retorts for the time being in this country, Everybody after that hesitated to employ what was well known to have been a failure. And then others interested in other methods took up the subject, and did not help the cause of inclined retorts much, as everybody knows. Today the inclines are firmly established. Eminent foreign and some American engineers have become convinced, after seeing them as I did in foreign countries, that they are a great improvement on the older method. The system has, therefore, been adopted extensivly abroad, and is being operated on a pretty large scale in this country even now; and more is to follow soon. The latest being at the works of the Consolidated Gas Company at East 138th Street, New York City, under the very able general supervision of Wm. R. Beal, now President of the American Gas Light Association, who, though long since passed the grade of superintendent, still seems to take a personal interest in

the subject, in which, as he told me, he thoroughly believes. His efforts are ably seconded by one of his assistants, Mr. Burgi, a Swiss engineer of many years of practical, successful retort-house experience. And I think we may look forward to this last installation in this country to bring about a generally more favorable impression as to the inclined retort system. The mistakes we made 12 years ago in construction have been long ago eliminated. No one, today, would erect inclined retorts without suitably bracing to prevent slipping into the fire-room. No one would ever erect benches back to back with a space of only about 7 feet between them. This was made possible with us by using long, bent mouthpieces and charging the retorts from the top of the bench.

Nobody would think of using such now. Short, flat mouthpieces—so we saw directly after firing our benches—would have been better, and no one uses any others now. If there are any installations of inclined retorts today in this country, which are not as perfect as they might be, it is because the models perfected years ago, yes, nearly 10 years ago, in England and Germany, have not been followed; and the mistake made against which I have raised a warning note not to fall into, namely, to try to put untried imaginary improvements into settings of inclined retorts, instead of using tried, well-established models, of which there are now a good many. Many American gas engineers have of late been abroad, and have seen the inclined retort system, and have become at last convinced, aye—and enthused, too, by this to any unbiased judge great improvement in the manufacture of coal-gas. That it is comparatively less costly in construction and operation than anything else, the by-product coke ovens not excepted by a long sight either, has been claimed, and to my mind proved to be a cold fact.

Such men as Chas. H. Nettleton, President of the New Haven Gas Light Company, of New Haven, Conn., a past President of the American Gas Light Association, of the New England Association of Gas Engineers, an honorary member of a number of technical bodies, and his engineer and superintendent, the able, old and experienced gas master, F. C. Sherman, have been very outspoken in favor of the inclined retort system. C. F. Pritchard, General Manager of the Lynn (Mass.) Gas and Electric Company, who surely is known to every reading gas man, and who now can show you one of the best designed, kept, and managed gas-works

anywhere, is another. All these contemplate using the inclined retort system, or certainly have so expressed themselves to me. "And there are others," and a good many of them, too, gentlemen. The preceding answers some of the questions that have been put to me by your worthy President, and let us now take up some of the other questions.

"What changes have been made to adapt inclined retorts to American conditions?" is one of them. I do not know that any changes are necessary. The Westmoreland Coal Company at one time sent a lot of their coal to England to have it used in the inclined, and try to see if the "Slip" some antagonists of the system made much of—without knowing much about it—amounted to anything. The result was most satisfactory. The inclined retort will need no change to adapt it to American conditions, but it will change those conditions very materially in favor of the gas company, its operating officers, and finally, its stockholders; and also greatly lessen the hard lot of the retort-house laborer, for when the inclined retort system is employed the importance of the brawny firemen will be wiped out right then and there. Anybody can make gas, draw and charge retorts perfectly; and an English gas engineer once said it was no longer man's work, woman could do it. As under reasonably favorable conditions over 100,000 cubic feet of gas can be produced by man per day with less physical exertion than it is possible in the old manual labor way to produce 30,000, and certainly less skill is required than with any mechanical stoker I have ever seen; the economy is at once understood. When operating on a sufficiently large scale to warrant the use of stoking machinery, should you desire to make comparisons, remember that in either case overhead coal bins and coal and coke conveying apparatus may be and are employed. But where with, say 20-foot retorts on the horiontal plan and stoking machines, two sets of bins must be used, one on each side of the house; with inclined retorts you require but one. And while that one must be larger than either of the other two, yet the fact that but one set of elevators and conveyors is required, and but one lot of bins, the whole consruction must be simplified and necessarily cheaper, while its effectiveness is not a bit less. And then the cost of the drawing and charging machinery has nothing to compare with it in cost with the inclined retort system, for the simple sheet-iron charging chutes certainly cost very much less in the first place, far less as to subsequent maintenance or repairs, and the retort

house, if you elect to have one, and not do as they do with the by-product ovens, viz., have no building at all—may be a good many feet less capacity than when machine drawing and charging, now grown obsolete, is indulged in. It is a little amusing to me when I hear advocates of stoking machinery say that inclined retorts are all right in works where stoking machines cannot be employed to advantage because they are too small, and pretty soon to hear some one else state that inclined retorts are all right for large works. The fact is, they are all right for any works, which reminds me of a short experience I had not yet two weeks ago when making an inspection for a banker of a gas plant he thought of buying. It was a pretty good coal-gas plant, but awfully run down. The superintendent asked me what I thought they needed most and before I thought the reply came: "You need a knowledge of the gas business; you need experience more than anything else." You know, gentlemen, that a grave mistake is often made in that direction, and that a first-class, well-appointed coal or water gas-works may be unproductive, or more so than need be, just because it has come to be believed, in some instances, that to know how to sell gas is everything, all else is so easy. Pardon this short digression. In my opinion, both the salesman and the engineer are necessary, each in his place. But it requires a practical knowledge and training only to be obtained by experience to enable one to obtain the best possible results out of a gas plant. It would certainly be easier to dump a charge of coal into a retort with a wheelbarrow than to lay in a good charge with a shovel. Anybody could do the former, using inclined retorts, but it does require considerable practice to do the latter well with a shovel and you know that the make per pound of coal is sometimes quite seriously affected by the manner in which the charging of the retort is done. So that works too small to employ coal-handling apparatus could yet use inclined retorts, and to some advantage. It has been asserted by competent authority that any coal-gas works making 50,000,000 cubic feet of gas per year, would find economy in using coal-handling machinery. This I will not state on my own authority, however, but do say that the inclined retort system, with a good, simple recuperative furnace, will pay any works to put up if they have to renew or newly erect benches. As the inclines require less floor space and only more height than horizontal retorts of like capacity, it will be found that some of the obstacles raised

against their use are only imaginary. The first cost of an installation of inclined retorts is not greater, or but little more so than that of horizontal retorts of like capacity; they require fewer repairs, last as long or longer in consequence, are more easily scurfed, just as easily patched if such should become necessary.

You have asked me to "give any data of operating costs or results which have not heretofore been published," and permit me to say that that is something I cannot do; for the subject of inclined retorts has been so thoroughly gone into, and the facts published, that while it is possible that I have some data not generally known, all has been published. My paper on "Inclined Retorts Up to Date," read at the meeting of the American Gas Light Association at St. Louis, in October, 1894, and published by that Association, contains figures which, though eight years old, may yet give light to the student of the subject at this present date. If any member of the Ohio Gas Light Association would like my views on any point not covered by this paper, I shall be pleased to hear from him and will gladly give him of the best of my basket.

A. H. Barrett's written discussion on the same subject was then read by Mr. Carpenter as follows:

INCLINED RETORTS.

A. H. BARRETT.

I have very little or nothing to add to what has already been said in the matter of inclined retorts. Our work here in Louisville is constantly improving as our acquaintance with the idiosyncrasies of the increased size of furnace and increased volume of heat required are appreciated. The difficulties, if I may call them such, have only been along similar lines to those which are experienced ordinarily in putting in regenerative furnaces.

Our working operations day in and day out are as follows: The charges are 700 pounds, burned off in 5 hours. The per cent. of coke consumed to that made is a little over 200 per cent. The stokers are worked in gangs of four men. These four men draw and charge 9 retorts per hour, making 216 draws per gang for 24 hours, representing 151,200 pounds divided among eight men, being four men on each 12-hour shift, which represents 18,900 pounds to each man per day of 24 hours.

As the question of handling coal and the subsequent delivery and treatment of coke has nothing whatever to do essentially with the inclined system, I omit any reference thereto.

I have only to say, in conclusion, that with my present experience, if I had the matter to do over again, there is no doubt as to my adopting the inclined system.

DISCUSSION.

PRESIDENT DOHERTY:—Any comments, gentlemen? Mr. Miller can give us any information on inclined retorts.

MR. MILLER:—Mr. President, I do not know that I can give you any information at all on inclined retorts. My observation extends only to one plant, and I know but very little about that.

PRESIDENT DOHERTY:—I am afraid you are not telling us all you know. I understand that you have just gotten through putting in a retort house and you did not put in the inclined retort.

MR. MILLER:—In regard to that, Mr. President, we think we are doing as well as anybody else has done with the inclined retort or any system. We are putting in horizontal retorts and stoking machines.

PRESIDENT DOHERTY:—I will now call for

UNFINISHED BUSINESS.

There is some unfinished business which has been laid over since last meeting. One question that was laid over at the last meeting was the question of increasing the dues of the members of this Association. At our meeting last year Mr. Persons said: "I have in writing here a proposition which I desire to submit to the Executive Committee. It is as follows: 'We, the undersigned members of the Ohio Gas Light Association hereby offer to the Executive Committee a proposition to amend Rule 10, page 5, of the Constitution so as to read that the annual dues shall be $4 per year instead of $3, as at present.' Signed by five members of the Association." That requires action at this meeting, as I understand it. I may state that the idea of that amendment was to raise money for the purpose of publishing our proceedings. As it now stands it is just the same as a motion before the house, duly seconded, for the raising of our dues from $3 to $4, and I presume all that the chair can do is to call for a vote on that motion unless some of you have some opinions that you want to air at this time or some lobby work.

MR. LATHROP:—I move that the Secretary be instructed to take a vote by mail increasing the dues from $3 to $4 per year, commencing with the year 1903. I also incorporate in the motion that the Executive Committee be empowered to so raise the dues, provided a majority of the members vote in the affirmative.

(The above motion, being duly seconded, was unanimously adopted.)

PRESIDENT DOHERTY:—I will now call for the

REPORT OF COMMITTEE ON NOMINATIONS.

To the Members of the Ohio Gas Light Association:

GENTLEMEN:—We, your Committee on Nomination of Officers for the ensuing year, would beg leave to submit the following:

President, C. W. Andrews, Hamilton, O.

Vice President, John D. McIlhenny, Philadelphia, Pa.

Secretary and Treasurer, T. C. Jones, Delaware, O.

Members Executive Committee—John Franklin, Cincinnati, O., and C. A. Schwarm, Lorain, O.

Editor Wrinkle Department, E. E. Eysenbach, Columbus, O.

Editor Novelty Advertising Department, B. W. Perkins, South Bend, Ind.

Respectfully submitted,

ISAAC C. BAXTER,
J. H. MAXON,
C. S. RITTER,
Committee.

PRESIDENT DOHERTY:—Gentlemen, you have heard the report of the committee. What shall be done with it?

A. P. LATHROP:—Mr. President, I move that the report of the committee be received and adopted, and also move that the President be authorized to cast the ballot of the Association for the election to office of the members therein nominated. (Seconded and carried.)

PRESIDENT DOHERTY:—Gentlemen, I take great pleasure in casting the ballot of the Ohio Gas Light Association for C. W. Andrews as President for the ensuing year, John D. McIlhenny as Vice President, T. C. Jones as Secretary and Treasurer, John Franklin and C. A. Schwarm as members of the Executive Committee, E. E. Eysenbach as Editor of the Wrinkle Department

and B. W. Perkins as Editor of the Novelty Advertising Department, and hereby declare these gentlemen duly elected to the respective offices to which they were nominated.

Messrs. Lathrop and Tayler were then appointed a committee to escort C. W. Andrews, of Hamilton, O., to the chair.

C. W. Andrews, the newly elected President, being escorted by the committee to the presidential chair, spoke as follows:

Gentlemen, I cannot begin to express to you how I appreciate this very high compliment which you have so generously tendered me. I trust that next year's meeting may at least in a measure justify your vote of confidence in electing me to this honorable position. I feel that you have already very materially assisted me in the work which you have given me to do by renominating and re-electing T. C. Jones as our Secretary and Treasurer for the ensuing year. We all know that to his efforts in the past have resulted in a large degree the success attending our meetings. In closing let me express to you again my most sincere thanks for the confidence you have reposed in me by electing me to this position.

John D. McIlhenny, of Philadelphia, Pa., being called on for remarks, said: Mr. Chairman and Gentlemen—I certainly have been very much surprised, and feel very much complimented and honored by this expression of your good will and confidence in having elected me to the office of Vice President of the Ohio Gas Light Association. I really feel that the committee has made a mistake in selecting me. I think there are many others who could have filled the duties much better than I can hope to do. I have always taken a great interest in the Ohio Association, and I have been attending the meetings without missing one, I think, for ten years. I certainly greatly enjoy them, as well as having very greatly profited by listening to the proceedings of this Association. They are most satisfactory and agreeable conventions. I feel glad every time to see the same people again, as well as having the privilege of meeting the new members who come in from year to year. I assure you I realize the great honor which has been conferred upon me, and I will do my utmost in every way to advance the interests of the Ohio Gas Light Association. I thank you.

T. C. Jones, of Delaware, O., the re-elected Secretary and Treasurer, being called on by the chair, said:

Mr. President and Gentlemen: This is the fifth time, I believe, I have been honored with this position. I assure you I appreciate it. I wish to say that I believe you will all join with me in the expression that the program this year has been a "howling success." The credit for the suggestion of the idea with reference to our program this year in having written discussions is entirely due to President Doherty. Being situated as we were 1,500 miles apart, it was a rather hard matter to get it in concise form. We labored with great difficulty. I hope that for next year's meeting when we ask the members for contributions they will not be backward, but will come right to the front and make the discussions at our next meeting as interesting and instructive as I am sure they have been at this meeting. Again I thank you.

PRESIDENT ANDREWS:—Before closing I would like to have some one make a motion to extend a vote of thanks to the Columbus Gas Company for hospitalities shown to us at this meeting, and to the retiring officers, whose efforts have proven so successful in making this a pleasant and profitable meeting. Also a hearty vote of thanks to the various members and gas men throughout the country who have assisted so materially in the success of this meeting by the very valuable contributions furnished.

MR. MCILHENNY:—Mr. President, I will make that motion. (The above motion was then duly seconded and unanimously adopted.)

JAMES W. DUNBAR:—Before closing the proceedings of this convention I desire on behalf of the Western Gas Association to extend to the members of the Ohio Gas Light Association a cordial invitaion to be present at our meeting in New Orleans, May 21, 22 and 23, 1902. The New Orleans Gas Company was very pressing in its invitation that we meet in their city, and the officers in charge have promised that if we go there they would see to it that we would have the best meeting the Western Association has ever had. While I think it hardly possible that we can have as many varied and important subjects so ably discussed as the Ohio Association has had at this meeting, yet on the whole I think that the members of the Ohio Association will find it both pleasant and profitable to be present. You are all cordially invited to meet with the Western Association at the time and place indicated.

HENRY L. DOHERTY:—Mr. President and Gentlemen: I wish to extend an earnest and cordial invitation to each member of the Ohio Gas Light Association to be present at the meeting of the National Electric Light Association, which will be held at Cincinnati, O., with headquarters at the Grand Hotel. By an inadvertence the date has been fixed the same week as the Western Association, but if possible that date will be changd, I think, so as to make it the week preceding. You are all cordially invited to be present at that meteing, and I am sure a special effort will be made to entertain you royally.

PRESIDENT ANDREWS:—I am sure this Association appreciates the cordial invitation extended to our members by the officers of the two other Associations, and on behalf of the Association I now take the liberty of thanking both Mr. Dunbar and Mr. Doherty for the cordial invitations thus extended. If there is no other business before the Association the chair will now entertain a motion to adjourn a most profitable and successful meeting.

It was then moved, duly seconded and carried that the eighteenth annual meeting of the Ohio Gas Light Association adjourn.

PROCEEDINGS

OF THE

Ohio Gas Light Association

Nineteenth Annual Meeting

HELD AT

THE GRAND HOTEL, CINCINNATI, OHIO.

March 18th, 19th and 20th, 1903

PUBLISHED BY THE ASSOCIATION
EDITED BY THE SECRETARY

NINETEENTH ANNUAL MEETING

OF THE

Ohio Gas Light Association

HELD

MARCH 18th, 19th and 20th, 1903.

PROCEEDINGS.

First Day.—Morning Session.

At 10 o'clock A. M. the Association was called to order by the President, Mr. Charles Woodward Andrews.

Upon roll call the following members reported their attendance:

Abbott, E. D.
Andrews, C. W.
Barnard, F. F.
Barnes, Geo. W.,
Barthold, W. H.
Baxter, Isaac C.,
Bender, W. E.,
Blinn, A. C.,
Blower, Frank W.,
Boyle, W. C.
Bredel, Fred,
Buck, Earle H.,
Butterworth, Irvin,
Carpenter, H. A.,
Cavanaugh, Frank,
Clansen, W. F.,
Clapp, G. N.,
Cline J. W. R.,
Cobb, B. C.,
Connelly, J. S.,
Coombs, Moses,
Corbus, F. G.,
Cressler, Alfred D.,
Daugherty, George,
Davidson, J.,
DeArmon, Chas. W.,
Dell, John,
Dickey, E. S.,
Doherty, Henry L.,
Dolph, A. M.,
Douglas, Henry W.,
Drouillard, G. L.,
Eaton, Alfred B.,
Elles, E. J.,
Eysenbach, E. E.,
Feurtado, R. S.,
Field, Frank H.,
Franklin, H. G.,

Franklin, John,
Gardner, W. H.,
Garrison, F. L.,
Gassett, A. L.,
George, Wm. B.,
Gillespie, Joseph,
Gray, A. Ross,
Gregory, John M.,
Guldlin, O. N.,
Gwynn, J. W.,
Hamlink, L. C.,
Hanley, E. W.,
Harper, H. D.,
Harris, J. A.,
Harrop, H. B.,
Hayward, Sterling F.,
Hedges, J. S.,
Henry, W. G.,
Hesser, C. F.,
Hickenlooper, Andrew,
Humphrey, A. H.,
Humphreys, E. C.,
Johnson, E. D.,
Jones, T. C.,
Kahn, Lazard,
Kellum, Benj.,
Kenan, Norman G.,
Knight, J. J.,
Knight, Wm. H.,
Landon, Hugh McK.,
Lea, Henry I.,
Leakey, Nathan G.,
Light, Joseph,
Lindsay, Chas. R.,
Lloyd, Ernest F.,
Low, D. W.,
Lynn, James T.,
McCormack, E. T.,
McDonald, Donald,
Albany, N. Y.,
McDonald, Donald,
Louisville, Ky.,
McIlhenny, John D.,
McMillan, John,
Malone, M. E.,
Mancourt, Edward M.,
Mansur, John M.,
Many, F. B.,
Mason, C. T.,
Mason, John T.,
Megie, Benj. F.,
Miller, W. H.,
Moon, O. P.,
Moses, Frank D.,
Mullen, John J.,
Olds, H. L.,
Palmer, L. T.,
Pattrell, C. D.,
Perkins, B. W.,
Perry, A. T.,
Persons, Fred R.,
Printz, Eugene,
Price, W. W.,
Ritter, Charles S.,
Roper, Geo. D.,
Russell, D. R.,
Schniewind, Dr. F.,
Schwarm, C. A.,
Sears, C. W.,
Schall, H. D.,
Shacklette, R.,
Shelton, F. H.,
Stacey, A. J.,
Stacey, F. A.,
Stacey, J. E.,
Steinwedell, W. E.,
Steele, Geo. P.,
Steenbergen, Chas. L.,
Stevens, J. G.,
Steward, Robt. Bruce,
Strain, G. A.,
Stone, F. W.,
Tittle, Scott M.,
VanWie, Edwin G.,
Wells, L. W.,
Wendler, B. F.,
Whysall, George,
Wickham, Leigh,
Witherden, G. M.,
Wones, W. R.,
Wordell, H. H.

President Andrews:—Gentlemen, it gives me great pleasure to introduce to you the Honorable Julius Fleischmann, mayor of the city of Cincinnati, who will welcome us to the Queen City.

ADDRESS OF WELCOME.

HON. JULIUS FLEISCHMANN.

Mr. President and Members of the Ohio Gas Light Association:

It is a very difficult matter just at the present time for me not to address an essemblage such as this as "Fellow Republicans." I hope there may be a few of them here to-day. It might be excusable on my part if I did not know exactly what I was saying at this hour of the morning, because last night I first attended a banquet by the Friendly Sons of St. Patrick, and later in the evening (or morning) I attended another affair under the auspices of the United Irish Society. That accounts for my being a little late. In the first place, let me say that during my incumbency as mayor of this city, extending over a period of three years, in welcoming similar gatherings, this is the first one I have been called upon to address which has been called to order on time. I suppose, however, that all gas people are prompt. At least I understand that our gas company is always prompt in sending in their bills.

A good many people have tried to tell me why you came to Cincinnati and why you meet annually in this way. One man who was connected with our local gas company, told me last night that it was in order to devise ways and means to get the best of the unsuspecting public. Seriously speaking, however, I know that you have gotten together for the purpose of learning from one another different methods of details connected with your business and to improve your opportunities and technical knowledge. But why you have come to Cincinnati we do not exactly know. Cincinnati is getting out of the way of gas. But we still are getting a good deal of gas from some of the members of our local company.

I simply want to tell you, gentlemen, in welcoming you to Cincinnati, that we have a real nice city, and we heartily welcome such organizations as this, because we like to show what we have. The people of Cincinnati are never so happy as when they are welcoming their friends from throughout the state of Ohio to their gates. We want you to make the best of your visit here.

We want you to benefit by your discussions and by what you may observe in your brief stay in our city. When you are through with your business we know that you will be well taken care of and that the local committee will show you what we have in Cincinnati, and we know they will succeed in giving you a very pleasant time indeed. All we want of you in return is that when you go to your respective homes you say a good word for Cincinnati. And we hope that your experiences here this time will create the desire on your part to come here soon again. I thank you.

PRESIDENT ANDREWS:—I will call on Mr. McIlhenny to respond to the address of welcome on behalf of our Association.

RESPONSE.

JOHN D. M'ILHENNY.

Mr. Chairman, Your Honor the Mayor, and Members of the Ohio Gas Light Association:

It is quite an honor to respond to the very felicitous speech of the honorabe mayor of Cincinnati, and I think we have all been much interested in his words of welcome. Observing his Honor to be such a young man, I am sure he will pardon the statement that this appears to be a country of young men. I met a man from Louisville, Ky., a few years ago, a man of about middle age and he told this story in connection with the young men of the West. He went to New York to promote a business enterprise involving the loaning of money on merchandise held in a storage warehouse, or, in other words, in bond. He went to the President of the Chemical National Bank, the leading bank of that day, and one of the leading banks of to-day for that matter, and stated what he wished done. After he was through, the President of the bank said to him: "That is all right; that sounds all very well, but you people out there are too young." Our friend from Kentucky replied: "Just give us a little time, and we will outgrow that." The middle west has outgrown it. People all over the country, East, West, North and South, know that the people of the middle west are a little force in this country. We know that out of Ohio has proceeded many successful enterprises, among which I include the Ohio Gas Light Association. Many politicians holding public office, both in Ohio and throughout the country, have hailed from the Buckeye State. They have

reflected credit upon their own state as well as upon the country. Ohio is a great state. We all know that. We all know that Cincinnati is a lively, enterprising, and prosperous city. We know it is not very far from the center, geographically, of the population of the United States and its fame is well known.

One thing has interested me within the last day. I came here yesterday morning and since that time I have noticed that the people of Cincinnati appear to be carrying out the Roman derivation of the name of their city. We see many Latin mottoes about Cincinnati. For instance, this hotel on its letter-head has a Latin quotation. Yesterday I visited the Franklin Gas Appliance Exchange adjacent to the office of the Cincinnati Gas and Electric Company, or the Cincinnati Gas and Electric Company is adjacent to that of the Exchange, I am not sure which. A large Latin motto was there displayed over an enormous reflector. I trust that all of these mottoes have an appropriate meaning. That reminds me that a few years ago I bought a straw hat in the summer time and after having taken it away from the hatter's I looked in the crown of it as we often do and saw there a Latin motto which translated into English meant "Nothing under the hat." I hope the Latin mottoes and maxims displayed in this city are equally as appropriate.

Mr. Mayor, on behalf of The Ohio Gas Light Association, we thank you for your cordial welcome to the Queen City. We always feel at home in Cincinnati, and after your cordial welcome I can only say that we now feel doubly so.

Mayor Fleischmann:—Gentlemen, just one word I desire to add. I have learned something since I sat down which was unknown to me before, and that is that I am not only welcoming men here from the state of Ohio, but from all over the United States. While as I said before, we are always happy to receive men from the state of Ohio within the gates of our city, when they come from a greater distance and from other states, they are doubly welcome. Everybody in the state of Ohio realizes, with the exception of one city in the state, that Cincinnati is the best city in the state of Ohio, and we want people who come from afar to learn that fact for themselves, so that they can go home and tell their friends about it. I am very much obliged, indeed, for your thanks and I assure you that what I said in welcoming you here was entirely sincere, and I trust you believe me and after I leave the room and the doors are closed in executive session, I hope you

will not whisper to one another that I have lied like the proverbial gas meter.

PRESIDENT ANDREWS:—I am sure we all appreciate very highly this cordial welcome which we have received from his Honor, the Mayor, and that we will all take pleasure in carrying out his suggestion when we go home by telling our friends what a hospitable city Cincinnati is.

The next order of business is the reading of the miuntes of the last annual meeting. What is your pleasure?

It was then moved by Irvin Butterworth, of Denver, Colo., duly seconded by Fred R. Persons, of Toledo, and carried that the reading of the minutes of the last annual meeting be dispensed with inasmuch as they have already been published and brought to the knowledge of the members of the Association.

PRESIDENT ANDREWS:—The next order of business upon the program is the report of the Executive Committee.

The report of the Executive Committee was then read by Secretary T. C. Jones, Delaware, O., as follows:

REPORT OF EXECUTIVE COMMITTEE.

To the Members of the Ohio Gas Light Association:

GENTLEMEN:—Your Executive Committee begs leave to submit for your consideration the following recommendations and report:

First: That H. L. Doherty, Moses Combs, and W. B. George be appointed a Nominating Committee.

Second: That Jno. D. McIlhenney, J. W. R. Cline, and R. Shacklette be appointed a Committee on Memorials.

Third: That George Whysall, F. W. Stone, and J. G. Stevens be appointed a Committee on Next Place of Meeting.

Fourth: That F. K. Pelton, C. S. Lomax, H. G. Thompson, J. F. Stuckenborg, C. T. Scovill, C. M. Gunther, J. H. Harbine, C. M. McLain, F. K. Wells, Henry J. LaKamp, John Mills, Geo. Matt and John Walters be released from membership at their own request.

Fifth: That Geo. E. Crisp and F. A. Wilk be dropped from membership for non-payment of dues.

Sixth: That the following be elected to active membership:

Baehr, William A., Superintendent Gas Department, The Denver Gas and Electric Company, Denver, Col.

Barnard, F. F., Superintendent Wilmington Gas Light and Coke Company, Wilmington, O.

Barthold, W. H., Superintendent of Manufacture, Grand Rapids Gas Light Company, Grand Rapids, Mich.

Blower, Frank W., Secretary and General Manager Kalamazoo Gas Company, Kalamazoo, Mich.

Buck, Earle H., Manager Citizens' Gas Light Company, Vincennes, Ind.

Cavanaugh, Frank, Manager The Consumers' Gas Stove and Fixture Company, Cleveland, O.

Cobb, B. C., General Manager Saginaw City Gas Company, Saginaw, Mich.

Dickey, E. S., Treasurer Maryland Meter Company, Baltimore, Md.

Dolph, A. M., President and Treasurer Paris Gas Company, Cincinnati, O.

Elles, E. S., Superintendent Gas Department, Evansville, Ind.

Feurtado, R. S., General Superintendent Western Gas and Investment Company, Chicago, Ill.

Franklin, H. G., Superintendent Public Lighting Cincinnati Gas and Electric Company, Norwood, O.

Gillespie, Joseph, Superintendent Washington Gas and Electric Company, Washington Court House, O.

Gray, A. Ross, Traveling Salesman, S. R. Dresser, Bradford, Pa.

Harrop, H. B., Chemist, Milwaukee Gas Light Company, Milwaukee, Wis.

Henry, W. G., Vice President Detroit Stove Works, Chicago, Ill.

Hesser, C. F., Superintendent Promotion Department, The Cincinnati Gas and Electric Company, Cincinnati, O.

Humphrey, A. H., President General Gas Light Company, Kalamazoo, Mich.

Kellum, Benj. J., Manager Welsbach Company, Chicago, Ill.

Knight, J. J., Vice President Kalamazoo Gas Company, Kalamazoo, Mich.

Lea, Henry I., Assistant Engineer Western Gas Construction Company, Fort Wayne, Ind.

Lindsay, Chas. R., Lindsay & Company, Chicago, Ill.

Megie, Benj. F., Manager Welsbach Company, Cincinnati, O.

Mullen, John J., Salesman The Schneider & Trenkamp Company, Cleveland, O.

Palmer, L. T., Secretary and General Manager Niagara Light, Heat and Power Company, Tonawanda, N. Y.

Powell, Wm. R., Secretary and Treasurer The Columbus Gas Company, Columbus, O.

Sears, C. W., Assistant Superintendent Mt. Vernon Gas Company, Mt. Vernon, O.

Schall, H. D., Salesman, Detroit Stove Works, Chicago, Ill.

Shacklette, R., Cashier Adrian Gas Company, Adrian, Mich.

Steinwedell, W. E., Secretary The Gas Machinery Company, Cleveland , O.

Tittle, Scott M., Inspector Springfield Gas Company, Springfield, O.

Wordell, H. H., Salesman Welsbach Company, Cincinnati, O.

Respectfully submitted for the Executive Committee,

Cincinnati, O., March 18, 1903. T. C. JONES, Secretary.

PRESIDENT ANDREWS:—Gentlemen, you have heard read the report of the Executive Committee. What is your pleasure?

On motion of J. W. R. Cline, duly seconded and carried, the report of the Executive Committee was adopted and ordered spread upon the minutes of the association.

ELECTION OF NEW MEMBERS.

It was then moved by Irvin Butterworth, duly seconded and carried, that the Secretary cast the ballot of the Association for the election to membership in the Association of the applicants recommended by the Executive Committee in its report.

SECRETARY JONES:—Mr. President and gentlemen, in complying with your motion, it gives me pleasure to cast the ballot of the Association for the election to membership of the applicants referred to. I hereby so cast the ballot of the Association and declare them duly elected members of the Ohio Gas Light Association.

THE PRESIDENT:—It is the desire of the chair and I am sure that it is also the desire of the other members present that the gentlemen whose applications have just been favorably acted upon and who are now members of the Ohio Gas Light Association will feel free to take an active part in these proceedings and we would be glad to hear from them in the discussions which are to follow. The next report in order is the report of the Secretary and Treasurer.

T. C. JONES, of Delaware, O., then submitted the following

REPORT OF THE SECRETARY AND TREASURER.

To the Members, the Ohio Gas Light Association:

GENTLEMEN:—I have the honor to present herewith the nineteenth annual report of the Secretary and Treasurer for the period between March 19, 1902, and March 18, 1903.

New members admitted at the eighteenth annual meeting	14
Released from membership	12
Deaths	2
Active members this date	225
Honorary members this date	13

Financial Report.—Receipts.

Balance from last year	$ 470	29
Received from dues	600	00
Received from initiations	65	00
Received from gas journals for report of eighteenth annual meeting	174	80
Received from sale of half-tones and etchings	21	30
Total	$1,331	39

Expenditures.

Printing and stationery	$ 268	38
Postage	30	25
Expense reporting eighteenth annual meeting	174	80
Secretary's salary	300	00
Expense of Executive Committee	20	85
Telegrams and telephones	12	44
Express	3	22
Badges	11	60
Balance on hand as per certified check	509	85
Total	$1,331	39

Respectfully submited,

T. C. JONES, Secretary and Treasurer.

Approved—JOHN FRANKLIN and F. W. STONE, Finance Committee.

It was then duly moved, seconded and carried that the report of the Secretary and Treasurer be received, adopted and ordered spread upon the minutes of the Association.

LETTERS OF REGRET.

SERCETARY JONES:—Gentlemen, we have received a number of letters and telegrams of regret, a few of which I will read, and the rest I will simply refer to by name.

NEW ALBANY, IND., March 19, 1903.

Mr. T. C. Jones, Secretary The Ohio Gas Light Association, Cincinnati, O.:

DEAR SIR:—I have entertained hopes until to-day of being able to attend the nineteenth annual meeting of the Ohio Gas Light Association, but duties prevent my leaving home.

Wishing you a successful and enjoyable meeting, and inviting the members of the Ohio Association to attend the next meeting of the "Western" at Indianapolis, May 20, 21, 22, I remain,

Yours very truly,

JAMES W. DUNBAR, Secretary.

SAN FRANCISCO, March 10, 1903.

Mr. T. C. Jones, Secretary The Ohio Gas Light Association, Cincinnati, O.:

DEAR SIR:—I regret exceedingly that circumstances make it impossible for me to be present at the nineteenth annual meeting of the Ohio Gas Light Association. The Pacific Coast Gas Light Association sends you its most hearty wishes for a successful and instructive meeting. Very cordially yours,

J. B. GRIMWOOD, Secretary.

SPRINGFIELD, O., February 28, 1903.

Mr. T. C. Jones, Secretary Ohio Gas Light Association, Delaware, Ohio:

MY DEAR MR. JONES:—I am this morning in receipt of your invitation to attend the nineteenth annual meeting of the Ohio Gas Light Association, March 18, and 20, at the Grand Hotel, Cincinnati. I assure you it would give me pleasure to attend, but I expect to be absent from the state on those days. I am

contemplating a trip to Florida and Cuba during the month of March, and shall therefore be deprived the pleasure of joining my fellow members of the Association on that occasion.

Hoping the meeting will be a most enjoyable and successful one in every respect, I beg to remain, with cordial regards,

Very truly yours,

ASA S. BUSHNELL.

Gen. John P. Harbison, of Hartford, Conn., telegraphs: "Congratulations and best wishes for successful meeting. Regret I cannot come."

Similar communications were received from Walton Clark, of Philadelphia; Alexander C. Humphreys, of New York City; Moses M. Granger, of Zanesville, O.; A. P. Lathrop, of St. Paul, Minn.; Paul Doty, of Detroit, Mich.; George G. Ramsdell, of New York City; Walter R. Addicks, of New York City; Atlon S. Miller, of Baltimore, Md.; M. B. Daly, of Cleveland, O.

F. H. Sheldon, of Philadelphia, telegraphs: "Best wishes for the best meeting held by the Ohio Association. Will join you Thursday morning."

VICE PRESIDENT McILHENNY then assumed the President's chair, and Charles Woodward Andrews delivered the

PRESIDENT'S ADDRESS.

C. W. ANDREWS.

The past year has been one of unparalleled expansion in the output of the gas companies in this country. This is due to several causes, among them being an awakening, begun several years ago, to the fact that the price of gas must be reduced to what then seemed an almost impossible figure. This has led to the pushing of the sales of gas, especially for gas cooking stoves, until at present the field has come to be one in which a great many companies have about settled down to a normal increase.

The introduction of the gas arc has again placed within our reach the immense store lighting business we lost when the electric arc succeeded the open flame, Siemes-Lungren and the earlier types of Welsbach lamps. I believe that with judicious selection of customers we can afford to install these lamps and maintain them in good order, charging the customer only the regular

counter prices for mantles and chimneys. In this way we place our service on a parity with that furnished by the electric companies, and the saving in cost will then give us this large and attractive business.

The time will shortly arrive, if it is not already here, when we will no longer have any reason for differential rates between lighting and cooking in the majority of our cities; because it has been thoroughly demonstrated that gas at $1 to $1.25 per 1,000 is cheaper than any other fuel for cooking, and the use of gas for this purpose has entirely passed the introductory stage.

The field which now offers the greatest possibility in the way of new business is that of domestic heating. You will note in looking over the program that this field has been given a very prominent place and I hope the discussion which will follow the papers will bring this fact home to all of you. The natural gas companies have for years catered to this field, gradually increasing the price of gas until 50 cents per 1,000 will, in a short time, be a common price.

The shortage of fuel this winter has brought to many of us an immense increase in the use of gas for this purpose and we could have sold much more if we had had a lower price for heating gas. I believe that we should adopt two prices, one for lighting and cooking, the other for heating, the heating price to be governed by local conditions.

In manufacturing there has been no special development during the past year. The by-product coke ovens have proven that they can furnish a satisfactory quality of gas, and where other conditions are right, can be used to advantage by fairly large companies.

One of our papers deals with the subject of benches, their construction and operation, and will prove very instructive.

In water-gas apparatus there has been a very decided tendency toward the use of larger sizes, thus showing the drift of this business.

The use of cement increases and concrete purifiers have become of more interest and will become more common as their cheapness of construction is better known.

In distribution the high-pressure lines are doing all that was expected of them. The tendency of the older companies is toward the use of high pressure feeders and district regulators. This results in a very flexible system and keeps down the investment remarkably.

Our Wrinkle and Novelty Advertising Departments, under the editorship of Messrs. Eysenbach and Perkins, respectively, continue to be of great assistance in bringing to the attention of the members new ideas and methods.

We have added two new departments, a Question Box and Department of Progress; the first under the editorship of Henry L. Doherty, might be termed "A Catechism of Gas Practices," consisting as it does of a list of over 600 carefully selected questions, with answers by those competent to deal with them. The Department of Progress under the editorship of Irvin Butterworth is intended to review all new methods, etc., which may from time to time appear in American and foreign journals. It is usually attempted to cover this ground in your President's address, but it cannot be done as satisfactorily as is desirable on account of the other matters demanding space.

As directed at the last meeting of the Association, the Secretary took a mail ballot on the question of increase of dues to $4 per annum. It was carried by an almost unanimous vote and the way is now clear for the publication of the proceedings of our Association:

During the past year death has removed from our midst two of our members: E. H. Jenkins, President of the San Antonio Gas and Electric Company, of San Antonio, Texas, joined the Association March 18, 1896. His death occurred June 23, 1902. Mr. Jenkins took great interest in this Association and was ever ready to give it his valuable assistance. He most successfully served as President of the Association at the Springfield meeting in 1899. We bow our heads in sorrow knowing that never again shall we receive the cordial greeting or the hearty clasp of the hand from friend and brother.

S. Milo Dole, Manager of the Adrian Gas Company of Adrian, Michigan, joined the Association March 19, 1902. His death occurred September 24, 1902. He was unknown to most of us, as he never affiliated by attendance at our meetings. But as a man is judged by the esteem of his neighbors, the report from his home justifies us in expressing our deep sorrow at his death.

In conclusion I wish to express my appreciation of the great assistance rendered me by your Secretary, T. C. Jones.

VICE PRESIDENT MCILHENNY:—Gentlemen, you have heard the address of the President. It is customary, I believe, that it be referred to a committee of three. Will some one make a motion to that effect?

It was then moved by Mr. Hayward, duly seconded and carried that the address of the President be referred to a committee of three, to be appointed by Vice President McIlhenny.

Vice President McIlhenny then appointed the following Committee on President's Address: James T. Lynn, Detroit, Mich.; Irvin Butterworth, Denver, Col.; B. W. Perkins, South Bend, Ind.

C. W. Andrews, resuming the President's chair, said: The next business upon the program is the Wrinkle Department, edited by Mr. E. E. Eysenbach, of St. Paul, Minn.

WRINKLE DEPARTMENT.

E. E. EYSENBACH, EDITOR.

NO. I. VALVE GEAR.

Mr. Elbert, Superintendent of the St. Paul Gas Light Company, has given me a description of a valve gear that he is using very successfully at his works.

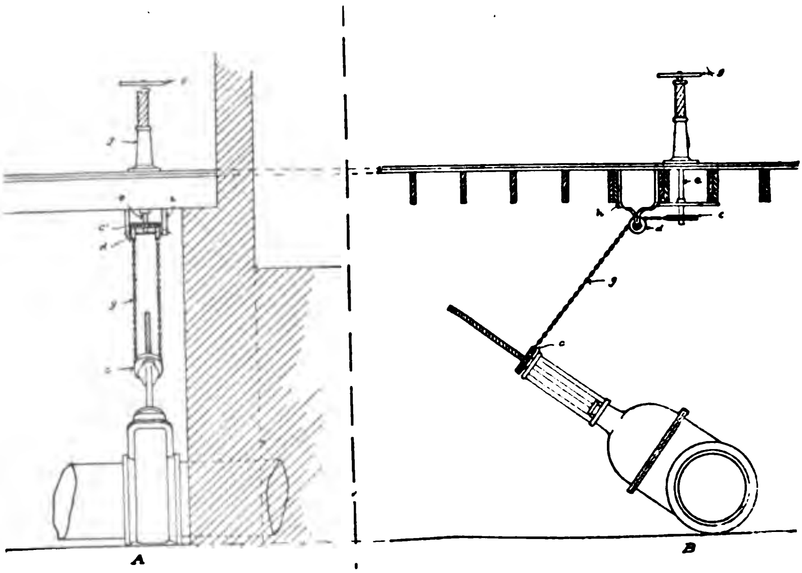


FIG. I. CHAIN GEAR CONNECTION TO INACCESSIBLE VALVE.

This gear is especially adapted for use where valves are not square with floor or on the same plane as valve stand. Also for any valve with inside or outside screw. This cut shows the latter. The sheave *c* has square hole in center and is placed over the

brass nut of valve. The sheave *c*, Fig. I., is left solid and drilled to fit valve stem.

The chain is special steel link and can be obtained from any chain block factory.

The groove wheels *d* are loose on the shaft held in position by a steel pin in the axle. At every corner turned, two of these wheels are necessary.

With the inside screw valve remove wheel from stem and place on sprocket wheel and proceed as per cut to complete.

NO. II. ELECTRIC ALARM GAGE.

F. H. Shelton sends a description of a device as fitted up and used by E. H. Grander, Assistant Superintendent of the Consolidated Schuylkill Gas Company, Royersford, Pa.

Fig. II is almost self-explanatory.

Any ordinary syphon gage, with rather large-sized tubes, is used. Tubes are filled with water to which about 10 per cent. of sulphuric acid has been added. The battery is charged pretty heavy to overcome resistance of water.

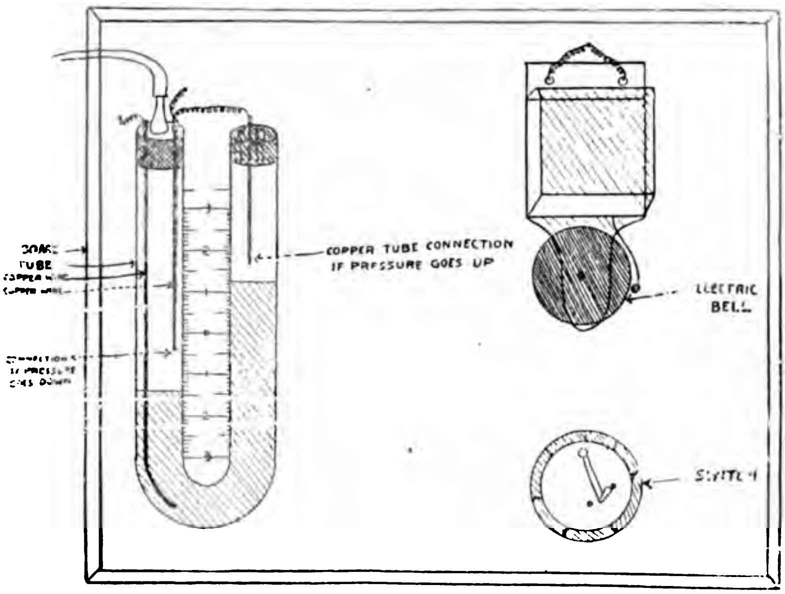


FIG. II. ELECTRIC ALARM PRESSURE GAGE.

Natural gas companies have used this device, filling the tubes with mercury, which forms a better electric circuit, but is not nearly as sentitive a gage as a water gage.

NO. III. STAND PIPE JOINTING.

F. C. Shepard, of Minneapolis, has asbestos rope, and found it a very successful substitute for the fire-clay and iron borings in common use for this purpose. It is quickly put in and easily removed, and makes a perfectly tight joint.

NO. IV. USEFUL RUBBER STAMP.

R. Shacklette, Manager of the Adrian Gas Company, Michigan, writes as follows:

"All gas companies say that failure to receive bill does not entitle consumer to discount after regular discount period; each consumer should therefore be notified when he has no bill by sending regular bill with words 'NO BILL' stamped on it."

This would be very useful where no minimum charge is made.

NO. V. VENTILATION FOR DOUBLE-FLOOR RETORT HOUSE.

The large amount of steam which collected below the charging floor in the double-floor retort house proved such a nuisance in cold weather that a 3-foot galvanized pipe was fastened on the wall of the house and carried up into the ventilators of the house. On the bottom of this pipe was put a hood slightly larger than the coke wagon. Coke is drawn into the wagon without quenching, and is drawn under this hood to be quenched. The pipe carries off a great part of the steam and a small steam coil in the bottom of the pipe induces a draft.

This wrinkle was contributed by H. W. Douglas, Manager of the Ann Arbor Gas Company, Ann Arbor, Mich.

NO. VI. SPRINKLER FOR SCRUBBER.

Contributed by V. S. Elbert, Superintendent of the St. Paul Gas Light Company. (See Fig. III.)

A—top of scrubber.
B—ordinary 4-inch flange.
C—4-inch plug tapped for ¾-inch pipe.
D—¾-inch coupling.
E—¾-inch plug.
N—¾-inch pipe.
M—3/16-inch iron rod.
P—circular *copper* plate—perforated.
X—water connection from steam pump.

The hole drilled in cap *Y* should be large enough to allow rod to vibrate. The lower end of pipe *N* should be as near top of scrubber as possible.

Water entering at *X* falls to perforated plate, causing plate to vibrate in ¾-inch pipe, causing water to spray towards the circumference of scrubber and perforations furnish the water for the center.

By altering the dish of the plate any desired distribution can be obtained.

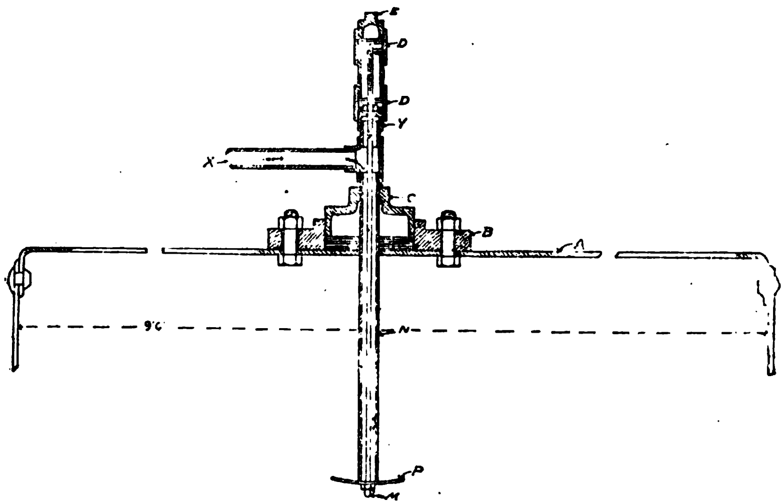


FIG. III. SPRINKLER FOR SCRUBBER.

NO. VII. AUTOMATIC INTERMITTENT SYPHON USED FOR FLUSHING SRUBBERS IN GAS WORKS.

A description of a similar device was contributed to this department by Mr. Baehr, of Denver, last year. This one, however, was not effected by the pressure in the scrubber, being entirely open to the atmosphere. A seal pot is suspended from the under side of the top plate of scrubber as shown on Fig IV. A similar seal pot is placed under the barrel. A number of small openings at bottom of outer pipe allow the water to fill inner space between the two pipes and to flow down through the inner pipe, starting the syphon.

This wrinkle was contributed by Mr. Malone, Superintendent of the Madison Gas and Electric Company, Madison, Wis.

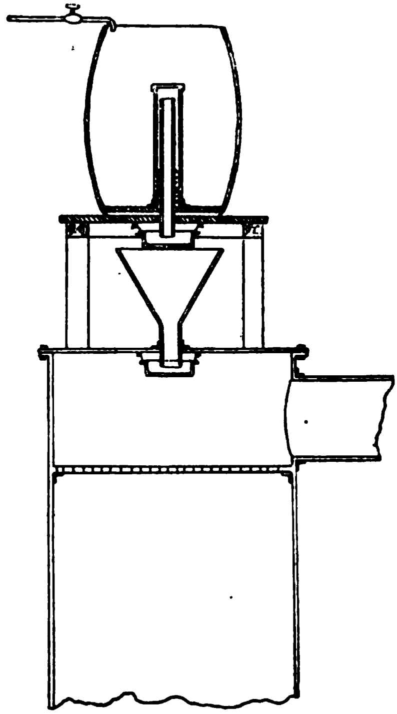


FIG. IV. SECTION OF AUTOMATIC FLUSH FOR TOWER SCRUBBER.

Upon motion of Mr. Persons, duly seconded, a hearty vote of thanks was then extended to Mr. Eysenbach for the Wrinkle Department.

THE PRESIDENT:—We will now take up for consideration the paper by W. A. Baehr, of Denver, Col., entitled "The Construction and Operation of Recuperative Benches." As Mr. Baehr is not in attendance I will request Mr. Doherty to read it.

Henry L. Doherty then read the following

CONSTRUCTION AND OPERATION OF RECUPERATIVE BENCHES.

W. A. BAEHR.

In spite of the importance which is attached to the recuperative bench as one of the components of a gas-works demanding the most serious consideration, very little attention seems to have been

given the subject of late. I will endeavor to cover the principal points concerning the operation of such benches in the first part of this paper, and to draw such conclusions thereform as will enable me to deduce certain lines of reasoning upon which to base the proper principles of construction.

In order to avoid the inevitable confusion arising from the use of terms not clearly understood, I will adopt the following definitions for use in this paper:

A *recuperative bench* is one in which both the primary and secondary air or the secondary only, are preheated by passing through a flue, or set of flues, without reversal in direction, and continuously; the transfer of heat being accomplished *through* the walls of the flues.

A *full-depth recuperative bench* is one in which both the primary and secondary air are preheated.

A *half-depth recuperative bench* is one in which the secondary air only is preheated.

These definitions give absolutely no chance for any misunderstanding concerning the actual size in feet or inches of a bench, but show fundamental principles by which they can be readily distinguished.

The first point which attracts our attention, and it is a very important one, is the proper regulation of the primary and secondary air. This matter is quite difficult to accomplish. The factor which determines the constancy of regulation is the resistance in the fuel bed, and this, as any one can readily see, is subject to continual variation. The depth of fuel, its distribution and degrees of fineness, and the varying accumulation of ash and clinker all influence the resistance very much. Of course the fuel should be maintained as level as possible in order that the whole bed should act uniformly, and not have one portion of it worked harder than other parts, resulting in the formation of clinker.

There is only one accurate method to determine the correct adjustment of the primary and secondary air, and that is by flue-gas analysis. We have tried all the time-honored wrinkles which have from time to time appeared in the proceedings of the various Gas Associations, but we never succeeded in getting really good results until we analyzed the waste gases.

FLUE-GAS ANALYSIS.

As the principal ingredients of spent, or flue-gases are CO_2, CO, O and N, and a determination of the first three is all that is usually required for furnace regulation, three solutions only are necessary. The reagents used for the absorptions are as follows:

For CO_2. A 16 per cent. solution of caustic potash. This solution also absorbs H_2S and SO_2 if present in the gas.

For O. An alkaline solution of pyrogallic acid C_6H_3 $(OH)_3$. Dissolve 20 grams of pyrogallic acid in 100 cc. of water. When about to use, mix some of this solution with its own volume of the potash solution.

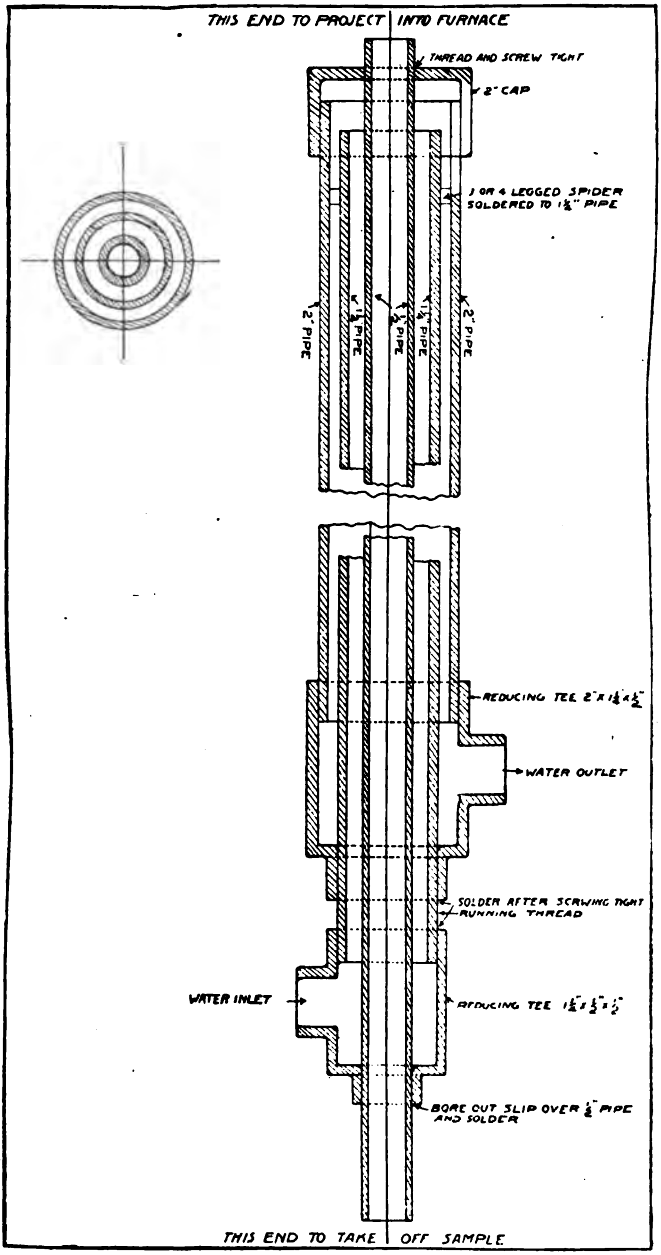
For CO. A strongly acid solution of cuprous chloride. Dissolve 15 grams of the red oxide of copper, Cu_2O in 100 cc. of strong hydrochloric acid, specific gravity 1.19. Keep this solution in a glass stoppered bottle with scraps of metallic copper.

These reagents must be applied in the order given or they will absorb other gases besides the one intended, unless such gases were first removed. There have been a great many reagents recommended, but the above are those used by Prof. N. W. Lord, of the Ohio State University, who is an eminent authority on this class of work. Furthermore, it is highly important that the same kind of solutions be used, as any other solutions will introduce time and other factors, which will produce varying results.

In a very great many instances the gases to be analyzed are so hot that it becomes very difficult to secure samples. In such cases a water-cooled tube used in connection with an aspirator is essential, and a design for such a tube is herewith appended. This design is made up of ordinary pipe and fittings such as are on hand in every gas-works. It is put together as follows:

The 2-inch cap is first tapped for a 0.5-inch pipe thread in center. Then the required length of 2-inch pipe is cut and threaded at both ends and the tapped 2-inch cap screwed on tightly. Next the 0.5-inch pipe is screwed into the 2-inch cap as shown.

Now, separately from the above, the correct length of 1.25-inch pipe is screwed into the 2-inch reducing tee with a running thread. At the other end of the 1.25-inch pipe a spider is fastened, so as to be a loose fit inside the 2-inch pipe. Then the 1.25-inch pipe is lowered into the 2-inch pipe, until the 2-inch reducing tee meets the end of the 2-inch pipe, and then it is screwed on tightly.



SECTION OF FLUE-GAS SAMPLING TUBE.

The only remaining thing is to put on the 1.25-inch reducing tee. This is readily done by boring out the 0.5-inch end of this so as to slip over the 0.5-inch pipe. The tee is then screwed home on the 1.25-inch pipe. Three joints then will have to be soldered as marked on drawing. This soldering is all right at these places for that end of the contrivance is not exposed to the heat.

The following short descriptions of various kinds of apparatus for flue-gas analysis will be of service to those who may wish to look up the subject:

In the Cooper tubes, or eudiometers, we have the simplest and cheapest of all gas analysis apparatus. A Cooper tube consists of a glass tube with a bulb at the closed end, and 2.5 inches from the open end the tube is bent so that the short leg reverses in direction from the tube and forms an angle of 45 degrees with it. Three sizes called respectively 10, 25 and 50 per cent. tubes will be found sufficient for gas analysis. They can be secured from Emil Greiner, 78 John Street, New York City.

The 10 per cent. tube is the one most generally used; it is 22.5 inches in length, and its volume to the 1,000 mark on the leg is 200 cc. This volume is divided into 1,000 equal parts, of which 100 parts, or 10 per cent., is contained in the graduated portion of the leg. Hence the name—10 per cent. tube. The graduated portion of the leg is divided into 100 equal parts, beginning at 900 near the bulb and ending at 1,000 near the bent end. Each division indicates one part in one thousand, or practically one-tenth of one per cent. of the whole volume. In order to bring the gas to constant temperature and pressure after each absorption is made the tube is placed in a large equalizing cylinder filled with water that has been in the room for some time.

The 25 and 50 per cent. tubes are arranged similarly to the above, except the percentage of the whole volume which is in the leg is 25 or 50 per cent. instead of 10 per cent. Gas analysis with these tubes is somewhat slow, due to the fact that the solution used for absorption must be removed and clean water run in to take its place before a reading can be taken in the equalizer. Any one interested can find a full description of these tubes and how to use them in a paper by O. O. Thwing, of St. Louis, read before the Western Gas Association in May, 1893. (*Progressive Age*, June 1, 1893, page 195.)

For analysis of furnace gases only the apparatus most generally employed is the Orsat-Muencke or some one of its modifica-

tions. The Orsat-Muencke apparatus consists of three absorption pipettes and one water-jacketed measuring burette complete in a traveling case.

The measuring burette has a capacity of 100 cc., and at its base is connected with a small bottle which contains water, brine, or mercury, by means of which the level of the liquid in the burette is raised or lowered so that the gases can be measured at atmospheric pressure. The top of the burette is connected by means of thick-walled capillary tubes to the three absorption pipettes, the inlet to each being regulated by a cock and the outlet being connected to a relief vessel.

The *first* pipette contains a caustic potash solution for the absorption of CO_2, the *second* an alkaline pyrogallic acid solution for O, and the *third* an acid solution of cuprous chloride for CO.

All absorption pippettes are filled with fine tubes so as to present a large surface of reagent to the gas. In the cuprous chloride vessel the tubes contain pieces of copper-wire to keep the solution in the cuprous state.

The gas is drawn into the measuring burette and 100 cc. of it are retained at atmospheric pressure and temperature. By raising the small bottle the gas is forced into the first pipette and the CO_2 absorbed, then it is drawn back and measured, the loss in volume being the percentage of CO_2 present, and the process is continued in a similar manner for the other constituents.

Another simple but very accurate form of gas-analysis apparatus is that known as the Hempel. It consists of a measuring burette and correction tube surrounded by a large water jacket. At the bottom of the measuring burette a regulation bottle or bulb is attached. There is included a series of absorption pipettes, one for each gas or combination of gases. The inlets and outlets of each pipette are made of heavy walled capillary tubes. Each pipette after receiving the gas from the masuring burtte can be detached, and thus the gas and the absorbing solution can be thoroughly agitated, producing a very rapid and complete absorption of the gas which is to be removed. Then the pipette is again attached to the measuring burette, the gas drawn back, and a reading taken at constant temperature and pressure. This process is then repeated for the other constituent gases.

There are many other forms of gas-analysis apparatus, among which may be mentioned Elliott's and Bunte's, and descriptions of these can be found in any of the trade catalogues of firms who

deal in chemical apparatus. I gave the above outline descriptions of the apparatus in common use, because the importance of flue-gas analysis demands it, and to direct such people who are intending to begin this kind of work to the best and most reliable methods of securing their results.

Since all the usual gas analysis apparatus give results by volume, and it is customary to give final results in per cent. by *weight,* it is necessary to reduce the per cent. by volume to per cent. by weight. This is most readily done by multiplying the percentage of each constituent gas by volume, by the density of that gas, then divide this product by the sum of the products of the multiplication of all constituents. Each quotient will then give the percentage by weight for that particular gas.

As the volume of a gas changes with variations of atmospheric pressure and temperature, it is necessary, in order to obtain a standard for comparison, to reduce all volumes as measured, to the volume which that quantity of gas would occupy at sea level atmospheric pressure, which is 760 millimeters of mercury, and also to 0 degrees C.

The following formula may be used to make these corrections:

V = the measured volume of gas.

t = temperature of this gas in degrees C.

p = atmospheric pressure at which the measurement was taken.

Then the

$$\text{corrected volume} = \frac{V \times 273 \times p}{760 \times (273 + t)}$$

The theoretical yield of CO_2 should be approximately 21 per cent. by weight. To balance the analysis, after reducing it to per cent. by weight, sum up all the oxygen in the CO_2, CO and O present, and compare it to the nitrogen. Atmospheric air contains very nearly 77 parts by weight nitrogen, and 23 parts by weight oxygen. From this relationship, which must necessarily hold true, the balance of any flue-gas analysis can be derived. If the nitrogen is not present in the ratio of 3.34 parts for every 1.0 part of oxygen, you may conclude your analysis is wrong.

CALORIMETRY.

Why do we take such pains to make careful flue-gas analysis, and to watch our draft with a hawk's eye, and still neglect the source from which we obtain our heat? How many of us know,

from day to day, the calorific value of the coal or coke we are firing in our bench furnaces and under our boilers? Most of the gas companies, and I may safely include the electric companies, contract for a certain kind of coal each year. This is generally of a variety such as would suit their conditions, and if the coal companies constantly furnished the grade specified all would be well.

But do they? Are they giving us the calories we are paying for? If not, how do *we* know they are not? Where does the burden of the blame lie?

There is only one way to settle this vexed question and that is by daily caloric determinations. And, to that end I suggest that in every company the superintendent be furnished with a daily report showing the caloric values of the fuels fired the preceding day, the flue-gas analysis from hourly or bi-hourly observations, and finally the *heat efficiency* of every furnace and of every apparatus that utilizes or transforms heat into other forms of energy.

Here is the keynote of success or failure, the real and unfailing standard by which to gage the performance of any machine. The heat efficiency,—how many engineers there are who do *not* reduce their observations to this basis,—*very few do.* I am afraid that altogether too few of us realize that all energy, whether chemical, mechanical, electrical or in other forms, is directly reducible and comparable on a heat basis.

Our several efficiencies, which result directly from the chemical actions taking place therein, are readily reducible to heat reactions. Our condensers and purifiers should be rated in the same way. Our boilers, water-gas plants, coal-gas benches, in fact, every apparatus used for transforming one kind of energy to another, should and can be treated as a heat machine.

In this paper I will treat recuperative benches purely from a heat standpoint. In order to give an idea of the various steps leading up to the subject it is necessary to include calorimetry and mention the different makes of machines. I will only give their names, as this paper would become too long otherwise. Full descriptions can be found in the catalogues of dealers.

VARIOUS MAKES OF CALORIMETERS.

The Carpenter, Parr, Mahler bomb, Favre and Silberman, Scheurer-Kestner, Meunier, Dollfus, Berthelot, Alexejew, Fisher-Thomsen, Schwackhoefer, W. Thompson, Barrus, Hartley and

Junker, Lewis Thompson, Andrews, Berthelot and Vielle, Atwater Krocker, Hempel, Walther-Hempel, Witz, Hermann, Herschel, Bunsen, Schulla and Wartha, Von Tham and Dieterici.

Full descriptions of the method of operating these can be found in "The Calorific Power of Fuels," by Herman Poole. The Mahler bomb, the Carpenter and the Parr are the most extensively used.

SPECIFIC HEAT OF GASES.

Before reaching the main portion of this paper it is necessary to give thorough consideration to one more preliminary subject, *viz.*, the specific heat of gases at various temperatures. During some years of study on "heat" there has been no more difficult or abstruse problem presented to me than this same subject. In the first place there are very few authorities who say anything at all about it, and those that do give the most remarkable series of variable and contradictory statements one could well imagine.

The ordinary text and reference books on physics give tables of the specific heat of gas at constant pressure and at constant volume, but say nothing which would lead one to suppose that these gases had a thermal capacity varying with the temperature. In fact I feel safe in saying that the average engineer, or college man, does not know that such a variation exists.

In the "Chemiker-Kalender," by Dr. Rudolph Biedermann, published in Berlin, Germany, the tables of specific heat of gases are expressly stated to be true only between certain ranges of temperature.

To show some of the research work done on this subject I will quote the following from "Nernst's Theoretical Chemistry," beginning on page 34. In this extract the temperatures are quoted in degrees C.

"A number of French investigators have recently succeeded in determining the specific heats of gases at very high temperature with quite a considerable degree of accuracy. Mallard and Le Chatelier (*Comptes Rendus,* 93, 1,014, 1,076 [1881]) exploded à gas mixture of known composition in a closed iron cylinder, and determined the maximal pressure developed thereby: This last measurement was performed at first with a Bourden's manometer, which recorded its data by means of a needle on an evenly rotating cylinder. Later these same investigators employed 'the crushing manometer,' constructed by Sarreau and Vielle (*Ibid.*,

95, 26 [1882]), on which the pressure was measured by the permanent deformation of a small, solid, copper cylinder placed between an anvil and a piston, on which the pressure to be determined acted; also here the time occupied in developing the pressure was determined by means of a needle and a rotating cylinder. Thus by measuring the maximal temperature, and since the heat developed by the explosion is known from the thermochemical data, there is given at once the heat capacity of the gas mixture. A correction must be made to account for the heat given off from the walls of the explosion bomb, which on account of the quick occurrence of the explosion is inconsiderable; this correction can be calculated from the velocity of cooling observed by the decrease of pressure after the explosion, or it can be determined quite accurately in the experimental way by the use of various large receiving vessels.

"From the fact that the maximal pressure of a gas mixture, for example 'knall gas,' when exploded with admixture of equal volumes of nitrogen or oxygen, or hydrogen, or carbon monoxide, experiences the same diminution of temperature, it follows that *these gases possess the same heat capacity up to the maximal temperature of explosion, i. e., up to 2,700 degrees.* This is true, provided that these gases have the same co-efficient of expansion up to these temperatures, something which can scarcely be doubted after the measurements of V. Meyer and Langer (Pyrochem. Unterss, Braunschweig, [Brunswick] 1885.)

"These results have been confirmed as well as broadened at several points by Vielle (*Comptes Rendus* 96, 1,358 [1883]), and also by Berthelot and Vielle (*Ibid.* 98, 545, 601, 770, 852 [1884]). It was shown later that nitrogen and carbon monoxide have the same heat capacity, by the explosion of a mixture of cyanogen and oxygen, which led to the formation of carbon monoxide and nitrogen; thus

$$C_2N_2 + O_2 = N_2 + 2CO.$$

"From the heat developed by this reaction and the maximal temperature observed, there could be calculated the specific heats of nitrogen and carbon monoxide. Finally, from further researches which were conducted with an excess of nitrogen, there could be stated the following formula for the molecular heat of N_2, H_2, O_2 and CO at constant volume, and which can be regarded as good from 1,600 degrees to 4,500 degrees, *viz.:*

$$4.75 + 0.0032\ (t - 1{,}600).$$

"For the latter temperature, 4,500 degrees, this formula gives 14.1, *i. e.*, the molecular heat of the permanent gases increases very considerably with the temperature.

"From observations on the maximal pressure in the explosion of hydrogen and carbon monoxide, in the presence of varying quantities of nitrogen, Berthelot and Vielle calculated the molecular heat of the water-vapor to be

$$16.2 + 0.0038 \ (t - 2{,}000),$$

and for that of carbon dioxide

$$19.1 + 0.0030 \ (t - 2{,}000).$$

Both formulæ refer to the molecular heat at constant volume.

"Later, Mallard and Le Chatelier (Wied. Beibl., 14, 364 [1890]), used in a very similar way the maximal pressures of various explosives as observed by Sarreau and Vielle, to calculate the specific heats of gases, and thus obtained results showing undoubtedly that the molecular heats of the 'permanent' gases increase strongly at higher temperatures.

"For the mean molecular heats at constant volume between o degrees and t degrees they found:

Carbon dioxide	$6.50 + 0.00387$ t.
Water-vapor	$5.78 + 0.00287$ t.
Permanent gases	$4.76 + 4.00122$ t.

At the same time they found that the molecular heat was independent of the pressure itself, at pressures of 6,000 to 7,000 atmospheres.

THE DEPENDENCE OF THE SPECIFIC HEAT OF GASES ON THE TEMPERATURES.

"It has already been repeatedly shown that the specific heat of gases steadily decreases with decreasing temperatures (the apparent exceptions exhibited by the vapors of acetic acid and of nitrogen dioxide at certain temperature intervals have been referred to the dissociation phenomena).

"As Le Chatelier noticed (Zeitschr. Phys. Chem. 1, 456 [1887]), this decrease indicates a tendency for the specific heats of the most different gases to approach *the closer, the more the temperature sinks, and at absolute zero the values of the molecular heats at constant pressure seem to converge at* about 6.5. The observations, therefore, can be represented by the formula,

$$Cp = 6.5 + aT,$$

in which T represents the absolute temperature and *a* represents a co-efficient which is greater according as the molecule is, *more complex*. The following values have been calculated for *a*:

Molecular Formulæ.	*a*.
H_2, N_2, O_2, CO	0.0010
NH_3	0.0071
CO_2	0.0084
N_2O	0.0089
C_2H_4	0.0137
$CH\,Cl_3$	0.0305
$C_2\,H_5\,Br$	0.0324
$C_3\,H_8\,O$	0.0403
$C_6\,H_6$	0.0510
$CH_3\,COOC_2\,H_5$	0.0674
$(C_2\,H_5)_2\,O$	0.0738

"If, for example, one calculates the mean specific heats measured by E. Wiedemann between 20 degrees and 200 degrees, with the help of the formula given above, he will find very good agreement. Also the values found by Le Chatelier at very high temperatures (as above) are in good agreement, since the true molecular heats at constant pressure calculated for — 273 degrees, for the following substances are:

CO_2	6.39
H_2O	6.22
H_2, N_2, CO_2, O_2	6.10

All are nearly equal and not far removed from 6.5."

The above extract from "Nerst's Theoretical Chemistry" gives the present state of knowledge, and some of the experiments performed to determine the specific heat of gases at high temperatures. A number of other investigators, some of high repute, have worked on this problem from time to time, but unfortunately their results do not present the uniformity of conclusions so much desired. I cannot enumerate all this research work, but a few instances are mentioned in the "Chemiker-Kalender" for 1902, and several articles on high-temperature work have appeared in the scientific journals during 1902, giving descriptions of experiments performed along these lines.

After looking through a large number of standard works of reference, and writing to several college professors of high standing, none of whom could give me the tables I sought, I was about

to give up hopes, when it occurred to me that perhaps Fred Bredel, of Milwaukee, could give me some information on the specific heat of gases at various temperatures. Mr. Bredel read two very able papers in 1892, bearing on the same subject as this paper, one before the Ohio Gas Light Association, entitled: "The Determination and Regulation of the Proper Proportions of Primary and Secondary Air and Steam in Regenerative Furnaces" (*Progressive Age*, April 15, 1892, p. 139) and the other before the Western Gas Association entitled, "The Advantages of Recuperative Furnaces in the Utilization of Heat." (*Progressive Age*, June 1, 1892, p. 194).

So I wrote to Mr. Bredel for what information he could and would give me, and great indeed was my pleasure at receiving the following reply:

My Dear Sir:—I herewith send you a diagram showing the specific heats. Most of them are calculated by myself and corrected to date. I have found that they are practically correct and give the average of all compilers where actual experiments have been made. I figured them out theoretically.

If in your article you want to mention the temperatures I wish you would mention the way I got to them. I compiled same from different authorities to as high a heat as actual experiments have been made, then found the co-efficient of increase and then checked back. Naturally the moment you would touch the dissociation point, something entirely different would happen, but as that is only just reached in the instance of water-vapor in actual firing the figures can be taken as correct, as they stand. The proof that it is very closely correct is that in theoretical calculating high temperatures by means of this table they coincide with temperatures that have been measured and this I consider the main check of their correctness. The actual calculations, unhappily, have been mislaid by me and only the original diagram as drawn by me, is left; and some of the figures have been proved to be correct since, where actual experiments have been made, and the table should stand as it is.

I have checked the table up from time to time as in the different scientific journals results were published, and I have never found any large discrepancy. There have been some where the discrepancy has been quite a little, but which we afterwards found out to be incorrect. Yours truly,

Milwaukee, Wis., Jan. 16, 1903. (Signed.) Fred Bredel.

This diagram gives the specfiic heat of some gases in terms of the centigrade scale, and was furnished me through the courtesy of Mr. Bredel.

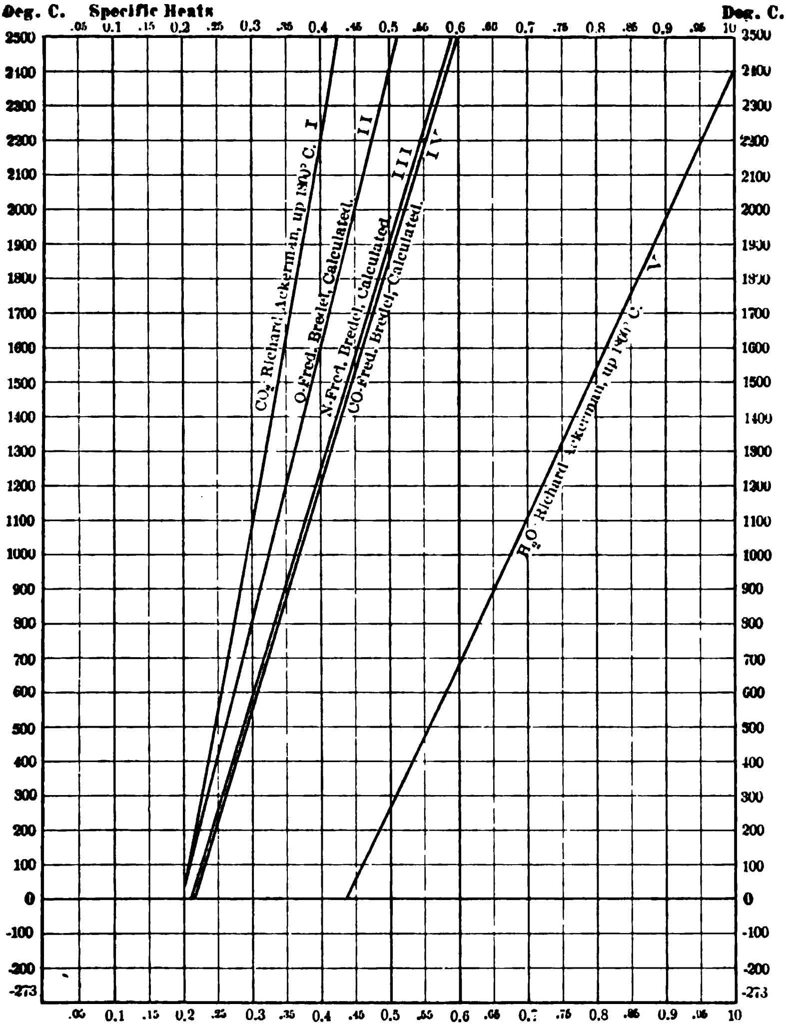


DIAGRAM SHOWING VARIATION IN SPECIFIC HEAT OF SEVERAL GASES DUE TO RISE IN TEMPERATURE.

ADJUSTING ASH-PIT WATER SUPPLY.

There is no question but that the water used in the furnaces to prevent clinkering has an important bearing on furnace operation. There should be enough water vaporized to keep the temperature of the fuel bed below the clinkering point, but in most works there is probably considerable excess of water used. The correct quantity can be determined experimentally, by starting with a large excess of water, and gradually cutting it down until clinkers just begin to appear, or *vice versa*. After the correct amount has once been determined it should be closely adhered to, and this can be done in the following way:

In the first place the water must be supplied with a uniform head. At Denver we formerly used surface water, but this corroded the pipes and stop-cocks so fast that an adjustment of flow would not hold good an hour. We thereupon changed our system to the artesian water supply, put in new pet-cocks, and the trouble has disappeared. There is an overhead tank fitted with a float-governed valve, in which the water keeps at a constant level. From this tank the leads run to the various stacks.

We figure the amount of water down to cubic centimeters per minute, and then by means of a graduated burette and a stop-watch we take a reading every day on each bench. By adjusting the pet-cock the correct amount is readily supplied.

Another important point in this connection is that if all the retort-house men are allowed to tamper with the air slides, water supply, and general furnace regulations, all the analyses of flue-gases, and calorimeter determinations that 0.5 dozen chemists could make would be of no avail. All this should be left in the hands of the retort-house foreman, and he should change adjustments only after proper tests have been made.

PYROMETER TESTS.

We secured a Heræus Le Chatelier Pyrometer from Charles Engelhard, 41 Cortlandt Street, New York City, and made a great many temperature determinations in our benches. This pyrometer cost $150, and is without doubt the nicest instrument for making high-temperature determinations on the market to-day. The elements used are platinum and platinum-rhodium.

In order to secure reasonably correct temperatures we adjusted a bench until the flue-gas analysis was very good, and then took readings. The following temperatures resulted:

	Temperatures.
Just above fire in furnace	1950° to 2,050° F.
In combustion chamber, 2 ft. above nostrils..	2,440° F.
In combustion chamber, 4 ft. above nostrils..	2,470° F.
Waste gases at top of recuperator	1,475° F.
Waste gases at bottom of recuperator	750° F.

Of course the temperatures vary somewhat from the front to the back of the benches, but we made several determinations at varying distances from the front with the foregoing average results.

In view of these tests I will use the following temperatures in my calculations.

	Temperatures.
Just above fire	2,000° F.
In combustion chamber	2,500° F.
Waste gases top of recuperator	1,500° F.
Waste gases bottom of recuperator........	750° F.

Our benches are full-depth recuperative benches of sixes, with retorts 15 x 26 inches and 9 feet long inside.

I will now give various estimates of bench efficiencies, and in order to simplify the figuring I will use the following specific heats:

SPECIFIC HEAT.		HEATS OF COMBUSTION.	B. T. U.
H_2O vapor ...	0.48		
Air	0.2379	C to CO_2 =	14,544
N	0.244	C to CO_2 =	4,400
CO_2	0.2164	CO to CO_2 =	4,348

The following computation shows the theoretical efficiency of a full-depth bench as compared to a half-depth bench, using *no* water in the furnaces.

EFFICIENCY OF BENCHES — FULL DEPTH.

For full-depth bench:

Heat Produced.

		B. T. U.
1 lb. C, 2.66 lbs. O and 8.88 lbs. N produce 3.66 lbs. CO_2 and 8.88 lbs. N..........................		14,544

Heat Lost.

Absorbed in raising 3.66 lbs. CO_2 from 60° to 2,500° F. = 3.66 lbs. x 0.2164 x 2,240	1,932	
8.88 lbs. N from 60° to 2,500° F. = 8.88 x 0.244 x 2,440	5,287	
Gross loss		7,219

Gross loss, (*carried forward*) 7,219

Heat Recovered.

From heated secondary air = 5.77 x 0.2379 x 2,440 .. 3,349

The flue-gases would have a specific heat of 0.236, and the temperature of the escaping gases at the bottom of the flues where secondary air is admitted would be:

$$2500^\circ - \frac{5.77 \times 0.2379 \times 2,440}{12.54 \times 0.236} = 2,500^\circ - \frac{3349}{2,959} = 2500^\circ - 1132^\circ = 1368^\circ \text{ F.}$$

The heat recovered from the heated primary air would therefore be 5.77 x 0.2379 x (1,368 — 60) .. 1,795

Heat recovered 5,144

The final temperature of the escaping gases would be

$$1,368 - \frac{5.77 \times 0.2379 \times 1,308}{12.54 \times 0.236} = 1,368 - \frac{1,795}{2,959} = 1,368 - 606 = 762^\circ \text{ F.}$$

Net loss of heat 2,075

Theoretical efficiency, full-depth bench, not allowing for radiation, opening of doors, etc., would be (14,544 — 2,074) ÷ 14,544 = ... 85.73%

EFFICIENCY OF BENCHES — HALF DEPTH.

For a half-depth bench the heat produced and the gross losses are the same as for a full-depth bench, as is also the heat recovered by absorption in the secondary air. But there would be no recovery in the primary air, and therefore the net loss for a half-depth bench would be 7,219 — 3,349 = 3,870 B. T. U.

The theoretical efficiency, with previously mentioned omissions, for a half-depth bench would then be (14,554 — 3,870) ÷ 14,544 = 73.39 per cent.

Now, in order to show the efficiency of a half-depth bench using varying quantities of water, I will give below the calculations when using 1 pound of water for every 10, 8, 6, and 4 pounds carbon.

First: 1 pound water for every 10 pounds carbon.

Heat Produced.	B. T. U.
9 1/3 lbs. C. burned with 107.71 lbs. air (82.88 lbs. N) to 34.16 lbs. CO_2 = 9 1/3 x 14,544	135,744
2/3 lb. C. burned with 1 lb. H_2O (1/9 lb. H.) to 1 5/9 lbs. CO = 2/3 x 4,400	2,934
1 5/9 lbs. CO. burned with 3.865 lbs. air (2.976 lbs. N) to 2 4/9 lbs. CO_2 = 1 5/9 x 4,348	6,764
Total heat of combustion	145,442

Heat Lost.

1 lb. H_2O from 60° to 212° F.	152
1 lb. H_2O, latent heat of vaporization	966
1 lb. H_2O entering flues at 2,500° F. = 1 x 0.48 x 2,440..	1,171
36.6 lbs. CO_2 entering flues at 2,500° F. = 36.6 x 0.216 x 2,440	19,325
85.856 lbs. N. entering flues at 2,500° F. = 85.856 x 0.244 x 2,440	51,115
2,976 lbs. N. entering flues at 2,500° F. = 2.976 x 0.244 x 2,440	1,772
Gross loss	74,501

Heat Recovered by absorption in secondary air, which is

1/2 of 107.71 = 53.85 lbs. to burn 9 1/3 lbs. C to CO_2 and
3.865 " " 1 5/9 " CO to CO_2 and
3.865 " " 1/9 " H to H_2O.

61.58 lbs. air which contained 61.58 x 0.2,379 x 2,440 B. T. U.	35,746
Net loss	38,755
Efficiency = (145,442 — 38,755) + 145,442 =	73.35%

This would give the flue-gases a specific heat of 0.238 and the temperature of the escaping gases would be

$$2{,}500^\circ - \frac{61.58 \times 0.2{,}379 \times 2{,}440}{126.4 \times 0.238} = 2{,}500^\circ - \frac{35{,}746}{30.083} = 2{,}500^\circ - 1{,}188^\circ$$
$= 1{,}312^\circ$ F.

These estimates, of course, do not allow for radiation, opening of doors, etc.

Second:. 1 lb. water for every 8 lbs. carbon.

Heat Produced.

	B. T. U.
7 1/3 lbs. C. burned with 84.63 lbs. air (65.12 lbs. N) to 26.84 lbs. CO_2 = 7 1/3 x 14,544	106,656
2/3 lb. C. burned with 1 lb. H_2O (1/9 lb. H) to 1 5/9 lbs. CO = 2/3 x 4,400	2,934
1 5/9 lbs. CO burned with 3.865 lbs. air (2.976 lbs. N) to 2 4/9 lbs. CO_2 = 1 5/9 x 4,348	6,764
Total heat of combustion	116,354

Heat Lost.

1 lb. H_2O from 60° to 212° F.	152
1 lb. H_2O latent heat of vaporization	966
1 lb. H_2O entering flues at 2,500° F. = 1 x 0.48 x 2,440..	1,171
29.28 lbs. CO_2 entering flues at 2,500° F. = 29.28 x 0.2164 x 2,440	15,460
68.096 lbs. N. entering flues at 2,500° F. = 68.096 x 0.244 x 2,440	40,542
2.976 lbs. N. entering flues at 2,500° F. = 2,976 x 0.244 x 2,440	1,772
Gross loss	60,063

Gross loss, (*carried forward*)	60,063

Heat Recovered by absorption in secondary air, which is
1/2 of 84.63 = 42.31 lbs. to burn 7 1/3 lbs. C. to CO_2 and
3.865 " " 1 5/9 " CO to CO_2 and
3.865 " " 1/9 " H to H_2O.

50.04 lbs. air which had absorbed 50.04 x 0.2379 x 2,440 = ...	29,047
Net loss = 60,063 — 29,047 = ...	31,016
Efficiency = (116,354 — 31,016) ÷ 116,354 = ...	73.34%

This would give the flue gases a specific heat of 0.240 and the temperature of the escaping gases would be

$$2{,}500^\circ - \frac{50.04 \times 0.2379 \times 2{,}440}{101.32 \times 0.24} = 2{,}500^\circ - \frac{29{,}047}{24.32} = 2{,}500^\circ - 1{,}194^\circ =$$
1,306° F.

Third: 1 lb. H_2O for every 6 lbs. carbon.

Heat Produced.	B. T. U.
5 1/3 lbs. C. burned with 61.55 lbs. air (4,736 lbs. N.) to 19.52 lbs. CO_2 = 5 1/3 x 14,544	77,568
2/3 lb. C. burned with 1 lb. H_2O (1/9 lb. H) to 1 5/8 lbs. CO. = 2/3 x 4,400	2,934
1 5/9 lbs. CO. burned with 3.865 lbs. air (2.976 lbs. N.) to 2 4/9 lbs. CO_2 = 1 5/9 x 4,348	6,764
Total heat of combustion	87,266
Heat Lost.	
1 lb. H_2O from 60° to 212° F.	152
1 lb. H_2O latent heat of vaporization	966
1 lb. H_2O entering flues at 2,500° F. = 1 x 0.48 x 2,440....	1,171
21.96 lbs. CO_2 entering flues at 2,500° F. = 21.96 x 0.2164 x 2,440	11,595
50.336 lbs. N. entering flues at 2,500° F. = 50.336 x 0.244 x 2,440	29,968
2.976 lbs. N. entering flues at 2,500° F. = 2.976 x 0.244 x 2.440	1,772
Gross loss	45,624

Heat Recovered by absorption in secondary air, which is
1/2 of 61.55 = 30.78 lbs. to burn 5 1/3 lbs. C. to CO_2 and
3.865 " " 1 5/9 " CO to CO_2 and
3.865 " " 1/9 " H to H_2O.

38.51 lbs. air which had absorbed 38.51 x 0.2378 x 2,440	22,354
Net loss = 45,624 — 22,354	23,270
Efficiency = (87,266 — 23,270) ÷ 87,266 = ...	73.33%

This would give the flue gases a specific heat of 0.239, and the temprature of the escaping gases would be

$$2{,}500^\circ - \frac{38.51 \times 0.2379 \times 2{,}440}{76.24 \times 0.239} = 2{,}500^\circ - \frac{22{,}354}{18.22} = 2{,}500^\circ - 1{,}227^\circ =$$
1,273° F.

Fourth: 1 lb. H_2O for every 4 lbs. carbon.

Heat Produced.

	B. T. U.
3 1/3 lbs. C. burned with 38.47 lbs. air (29.6 lbs. N) to 12.2 lbs. CO_2 = 3 1/3 x 14.544	48,480
1/3 lb. C. burned with 1 lb. H_2O (1/9 lb. H to 1 5/9 lbs. CO. = 2/3 x 4,400	2,934
1 5/9 lbs. CO. burned with 3.865 lbs. air (2.976 lbs. N) to 2 4/9 lbs. CO_2 = 1 5/9 x 4,348	6,764
Total heat of combustion	58,178

Heat Lost.

1 lb. H_2O from 60° to 212° F.	152
1 lb. H_2O latent heat of vaporization	966
1 lb. H_2O entering flues at 2,500° F. = 1 x 0.48 x 2,440	1,171
14.64 lbs. CO_2 entering flues at 2,500° F. = 14.64 x 0.2164 x 2,440	7,730
32.576 lbs. N. entering flues at 2,500° F. = 32.576 x 0.244 x 2,440	19,394
2.976 lbs. entering flues at 2,500° F. = 2,976 x 0.244 x 2,440	1,772
Gross loss	31,185

Heat Recovered by absorption in secondary air, which is

1/2 of 38.47 = 19.24 lbs. to burn 3 1/3 lbs. C to CO_2 and
3.865 " " 1 5/9 " CO to CO_2 and
3.865 " " 1/9 " H to H_2O.

26.97 lbs. air which had absorbed 26.97 x 0.2379 x 2,440	15,655
Net loss = 31,185 — 15,655	15,530
Efficiency = (58,178 — 15,530) ÷ 58,178 = ...	73.31%

This gives the flue gases a specific heat of 0.240, and the temperature of the escaping gases will be

$$2{,}500^\circ - \frac{26.97 \times 0.2379 \times 2{,}440}{51.16 \times 0.24} = 2{,}500^\circ - \frac{15{,}655}{12.28}\, 2{,}500^\circ - 1{,}275^\circ =$$
1,225° F.

I wish to state frankly that the reason for using the commonly accepted specific heats of gases in the foregoing calculations, instead of getting the mean co-efficients of thermal capacity from Mr. Bredel's diagram, was not only to make the work easier, but for a far more important object. This object is as follows: There is to-day no longer any question but that the specific heat of gases varies at different temperatures, but there is no authority as yet whose co-efficients have been universally checked and accepted. Mr. Bredel deserves great credit for his attempt to get at the truth, but as he himself admits that the main check of the correctness of his diagram comes from the agreement of certain

observed temperatures with the temperatures calculated by aid of it, I feel that further and more scientifically accurate experiments must be made before we can accept his results.

Now, it will be observed, that in the previous calculations of the heat reactions taking place in a *full* depth bench with no water used in the furnaces that the final temperature figures out as 762 degrees Fahr. This is not far from what it should be, according to actual measurements.

From the foregoing discussion certain obvious deductions as to construction necessarily follow. The first point arising is the

BENCH DESIGN — SHAPE OF THE FURNACE.

Since that geometrical figure which possesses the greatest area for the least length of enveloping line is the circle, it follows that furnaces should have a circular horizontal cross-section theoretically in order to get the least wall surface. However, in practical bench construction, this shape is not feasible except in producer firing, in which case the producer can certainly be made circular.

In practical bench construction various considerations require that furnaces should be rectangular in shape. Now in order for any right angled figure to have the largest area for the least perimeter it must be a square. Again, practical considerations step in and require that the furnace be longer than it is wide. But the perimeter of any rectangle grows less as it approaches a square, that is, of course, for the same area. From this it readily follows that the furnaces should be made as wide as possible, consistent with construction requirements, or in other words, that it should approach a square as nearly as may be.

Further, narrow furnaces are very uneconomical and hard to operate. That this is true will appear from the following discussion on the

EFFECTS OF UNEVEN DISTRIBUTION OF FUEL.

It seems almost an axiom to me that the fuel should be distributed evenly. By this I mean not only that it shall present a horizontal upper surface, but also that it shall be as nearly as possible a homogeneous mass. Of course if the grate bars are inclined the upper surface of the fuel should be parallel to them. A fuel bed cannot be homogeneous if here and there large lumps occur in it, interspersed with varying masses of finer material, or lumps of clinkers.

Now an uneven fuel bed naturally possesses varying resistance in its different parts. The least resistance is apt to occur along the wall, hence the less wall the better, for any given area. Further, the back of the furnace generally has a shallow fuel bed. It is a comparatively simple matter for the retort-house foreman to insist that after every firing the fuel bed should be levelled with a poker. Since the velocity of the air passing through the fire results from the differential pressure above and below it, and also from the resistance it encounters, it is certain to have a high velocity in places of low resistance, and a low velocity in places of high resistance. What is the result? It is simply this: Where high velocity occurs the carbon in the fuel burns directly to CO_2 and remains CO_2 through the bed, or at least in a great measure. This means a high-flame temperature, so high that the ash is fused and clinkers result.

It is well established that the reactions taking place in a producer are first that the lower carbon burns to CO_2. This, or passing up through the fuel bed is reduced to CO by taking on an atom of carbon. This reduction absorbs heat. Therefore the temperature is thereby lowered.

Now heat is a form of energy. It is another axiom in physics that no matter now great the force (or energy) exerted on a mass of matter, however small, it takes a *finite* length of time to start motion. Applying this axiom to the above dissociation of CO_2 into CO, we see that *no matter how great the heat (energy, force) nor how small the mass of CO_2, it must take a finite length of time to effect the reduction.*

Thus we see that the question resolves itself as depending for one thing on the velocity of the air through the fire. Just what that velocity is I do not know, but I do know that when there is a very shallow spot in the fire we get large quantities of CO_2 above the fuel bed, and this has already done mischief by producing clinkers, and can do no good at the retorts, because it cannot burn, and its only and slight value is to help heat the incoming secondary air, both in the combustion chamber and through the recuperator walls by its sensible heat.

A long, narrow furnace inevitably has a shallow fire in the back, it has the longest perimeter for a given area, the fuel catches or arches across it due to the proximity of the side walls the water is hard to distribute, it clinkers badly, is harder to clean, and, to use a slangy but highly expressive pharse, " it don't deliver the goods."

Since the fuel at the bottom of the fire burns directly to CO_2 a local high temperature is there produced. This is prevented by vaporizing water, and this vapor, due to its high co-efficient of thermal capacity and high dissociation temperature, prevents clinkering. This very prevention of clinkers is a loss of heat, and therefore the efficiency of using water is not 100 per cent., even though the hydrogen burns back to the water. Therefore, only enough water should be used to prevent fusing of ash, and not a drop more.

GRADE AREA. — DEPTH OF FUEL.

Producer practice, which in one sense of the word is farther along scientifically than illuminating gas-bench construction, has determined that 12 pounds of coal per square foot of grate area per hour is about the limit of good practice. Gas engineers could well study this problem before jumping into designs. Owing to the fact that furnace cross-sections are usually rectangular, thereby greatly increasing the wall surface per square foot of grate area over what it would be with a circular cross-section, I doubt if it is safe to figure on a value exceeding *8* pounds of *carbon* per square foot of grate area per hour. The grate area, therefore, should probably be designed on this basis, or very near it.

In regard to the depth of a fire, it should be just deep enough to convert all the CO_2 into CO. This will become apparent from the following discussion on

FLUE DESIGN.

The fundamental requirement of the flues is that they present the least resistance possible, on account of leakage between the air and gas flues. This also effects the fire-bed depth, as that constitutes a portion of the resistance. In other words, the fire should be as shallow, and the flue as large in cross-section as possible.

Leakage varies directly as the perimeter, and as the square root of the pressure. By doubling the perimeter, length remaining the same, we double the leakage, but by doubling the pressure we only increase the leakage approximately 41 per cent. The leakage curve for increments of perimeter would be a straight line, while that for increments of pressure would probably be a parabalo. By plotting both these curves on one sheet, and bearing in

mind that the pressure would be greatest for the least perimeter, and *vice versa,* it seems reasonable to assume that the point where the two curves crossed would give the proper flue-area to use. I think this is a *most valuable suggestion,* and the credit for it belongs to Henry L. Doherty.

The thickness of the walls of the flues also affects the heat transmission. Mr. Bredel, in his paper before the Western Gas Association in 1892, publishes a diagram showing the number of B. T. U. transmitted through the firebrick walls of different thicknesses per 100 square feet of surface for various differences of temperature in degrees Fahr. between the inside and outside. This is a very valuable diagram, and shows the superiority of thin walls for this purpose.

HEAT LOSSES DURING OPERATION AND THEIR EFFECT ON BENCH DESIGN.

In regard to recuperation it is surely true that, for maximum economy, this should be carried to its ultimate, although this is contrary to general belief. It may even be necessary to use supplementary iron recuperators, but such practice points strongly in favor of isolated generators and producer-gas firing, and not to the present constructions.

Concerning radiation, and in fact all losses, it is unnecessary for me to go into figures, as Mr. Bredel in the above-mentioned paper has calculated them, and any one interested can refer to same. I might suggest, however, that hollow tile be used in bench construction, as the air is a most excellent non-conductor of heat. Likewise the retort doors and the mouth pieces could be asbestos-lined and same covered with a thin iron sheeting inside to hold it in place and prevent injury to it. Also some heat could be saved if automatic stack dampers were provided which would close whenever the furnace doors were opened. All these would tend to increase the life of the bench.

In regard to the shape of the retorts, we have, perhaps, unconsciously, hit upon the best possible cross-section, *viz.:* The dome shape. Any one can readily see that the heat-reflecting properties of the inner and upper surface of that shape are excellent. There is at present no visible improvement that can be effected in this particular.

Finally, I wish to say that I have endeavored to cover the principal points of bench construction and operation in this paper.

Owing to lack of time it has been written in a hurried and somewhat disjointed manner, particularly in respect to the heat reactions. I had hoped to be able to show the calculation when using the mean specific heat co-efficients as given in Mr. Bredel's diagram, but must defer this until some future time.

DISCUSSION.

W. A. Miller:—Mr. President, I would like to ask Mr. Doherty how frequently he is able to make these tests of flue-gases in each bench.

Mr. Doherty:—If some of the conclusions Mr. Baehr suggests here are not correct it will start a controversy which will result in clearing up these particular points. He touches upon some things that I do not think have been touched upon before by any author who has treated this subject. The attempt was to make this a popular paper, and make it a paper that would be useful to every man whether he had a technical education or not. It is almost impossible to touch upon some of the details of furnace work, and yet do it in a popular way. None of the mathematics contained in this matter—in fact it is simple arithmetic—is hard to follow if anybody cares to follow it. Mr. Baehr has, perhaps, left himself open to criticism on one or two points. This work will go on in the same way it is progressing now during the ensuing year, so that additional points may be brought up in the near future. Mr. Miller wants to know how often we find it necessary to analyze our flue-gases. When we started to improve our furnace results we found it necessary to keep practically two men at it constantly. Now we find it necessary simply to have a man go around each morning and see that the water is properly regulated. We have no periodical time for analyzing the flue-gases. As soon as the bench commences to take a little more coke than it has been taking, or than it did take when the operator finished putting it in shape, then we go after the bench again, but we do not pretend to do it regularly, because we can tell about how much coke it is taking. And if there is any tendency for the coke to burn down we immediately go to work on that bench. I doubt if we are devoting now 30 hours' time a month, or the equivalent of one hour's time every day to this work. I doubt if we even devote 10 hours' time per month to our benches. We do not have to. Although at first we were devoting probably about 16 hours a day trying to get the benches in good shape. Our

fuel conditions are so different in Denver that for me to state the amount of coke required to burn off a ton of coal would not mean anything so far as other localities are concerned, where these peculiar conditions do not prevail. By careful furnace work we have succeeded in cutting down our consumption of coke per bench per day fully 25 per cent. So you see the work we have put on it has paid for itself already, and it will keep on paying for all time to come.

J. W. R. CLINE:—How many benches do you operate, Mr. Doherty?

MR. DOHERTY:—We operate 20 benches of 6's.

MR. LYNN:—Do you weigh the coke you use in your furnace so as to keep track of the amount of coke in determining whether the furnace is working properly? Is every pound of coke weighed as it goes into the furnace or has it been previously weighed? You say that you calculate a saving of 25 per cent. and I would like to know how you arrive at that result.

MR. DOHERTY:—We do not weigh all of the coke. But every once in a while we weigh the coke hot without adding any water, in that way determine the amount of coke produced from a ton of coal, and then we constantly check up on our coke bill to tell how much of that we are getting and then at periodical intervals we weigh the coke charged up to our benches. Instead of drawing it directly into the benches we draw it into a barrel and weigh it, but the difference is so great that when I say 25 per cent. I know that I am within reasonable limits. It easily shows up in commercial results. The difference is so great that I am sure that my statement of 25 per cent. is a conservative statement so far as the results are concerned. We might be wrong a per cent. or two, but I know that it is considerably above 20 per cent.

MR. LYNN:—The results so far as the commercial end of it is concerned is what a gas man would want to know.

MR. DOHERTY:—We can tell the difference by the cash in the drawer.

MR. BREDEL:—The only thing that I think is wrong in this paper is the statement as to the low temperature in the combustion chamber, and it can possibly be explained by the large percentage of ash. He gives the temperature as being only 2,470 degrees Fahr. Now, from the experience I have had from my benches I would say that the temperature of the combustion chamber is more than that. I have melted two-millimeter platinum wires

more than once to my sorrow, so that I think the temperature must be far above the amount stated by Mr. Baehr. I know that it is above the melting point of platinum.

MR. DOHERTY:—What temperature do you think exists, then, above 2,400 degrees Fahr.?

MR. BREDEL:—I stated in a paper published some time ago exactly how much the temperature was, but I have not the data with me. I did not know that this subject was going to be brought up, otherwise I would have prepared for it. I know, however, that the temperature is stated too low in the paper because it takes nearly 2,000 degrees Fahr. to carbonize the coal, and I know that the degree of temperature is above the melting point of platinum?

MR. DOHERTY:—What instrument shall we use then if platinum melts?

MR. BREDEL:—I used Seamon's Selen pyrometer.

MR. DOHERTY:—Is that an air pyrometer?

MR. BREDEL:—No, it depends upon the resistance of Selen and the temperature is measured directly by the radiation. I know the temperature is above the melting point of platinum because I wired two tubes together, and the wiring was done with two millimeter platinum wires and I got part of it out and part of it stayed in the furnace, but I could see where it was melted all right.

MR. DOHERTY:—Mr. Bredel's statement would indicate that the temperature in the furnace was above 3,400 degrees Fahr. We have inserted this pyrometer in our furnace with impunity. I cannot see eactly why the excessive amount of ash would affect the flame temperature. It should not. We are burning carbon and the only bad effect that the ash would have would be that it would reduce the flame temperature to the extent of the thermal capacity, which of course is very low. I agree with Mr. Bredel in his statement that some of these measurements seem to be wrong. I have always figured the temperature of the combustion chamber at about 2,500 degrees up to 3,000. I have never figured them as high as Mr. Bredel, and as a rule I have assumed that the temperature at the top of the recuperators was about 2,000 degrees. Mr. Baehr, I see, gives it as 1,475. I think that would indicate that it is wrong. In this paper, however, Mr. Baehr has simply given what he has found at the time. We had just gotten this pyrometer and he hurried up to make some measurements in

order that he might incorporate the results in the paper. I would like to have Mr. Bredel tell us more about this Seamon pyrometer. I do not understand what material was used for that portion that went into the furnace .

MR. BREDEL:—It doesn't go into the furnace. It is outside of the furnace.

MR. DOHERTY:—You place it then outside the furnace and the resistance of this material changes, and you measure the resistance by placing it against the Wheatstone bridge?

MR. BREDEL:—Yes, the resistance varies with the quality of the light admitted. Coming back to the furnace, the large amount of water-vapor that has to be admitted on account of the ash decreases with the flame temperature or tends to keep the flame temperature down. The water-vapor would decrease the flame temperature necessarily to a very considerable extent.

MR. DOHERTY:—As I understand Mr. Bredel he says that we would need more water-vapor because we had more ash. But I do not think that would necessarily follow because what we have to do is to keep the flame temperature of the furnace proper down below the fluxing point of ash. I do not think the quantity of ash would necessarily induce a lower temperature. All we have to do is to keep the temperature—whether there is much or little ash—simply below the fluxing point of the ash. Mr. Bredel has referred to this Seamon pyrometer, and, as I understand, it measures radiant heat.

MR. BREDEL:—Yes.

MR. DOHERTY:—Recently, in a discussion we had on lamp filaments and the efficiency of the Nernst lamp, I had occasion to look it up and see whether the primary law upon which radiation has been based was correct or not; in other words, whether all solid bodies would have the same temperature if giving out the same amount of radiant energy. I can find this law quoted and quoted again. But as far as I can ascertain, the law has never been finally determined, and I do not believe it is possible to determine it. I believe the character of the substance heated would affect the amount of radiant energy given out. One substance at one temperature would give off an amount of radiant energy differing from that of another substance at the same temperature. In fact, we know in the case of carbon lamp filaments that the surface of the filament has a great deal to do with its light-giving properties. If it is bright and smooth, and has a metallic finish,

it is much more efficient than when dark and rough and has no metallic finish. Pyrometrical tests of this character must be based upon the assumption that the amount of radiant energy will always bear an exact relation to the total energy. Then it is easy for me to conceive how one might secure results due to focusing of radiant energy. Once upon a time I designed a dome furnace—before electrical furnaces were available—to get a higher temperature from the same combustion. The plan which had occurred to by mind was that the dome should be so shaped that it would reflect all of the heat to a point in the bottom of the furnace. If one obtained anything like a focusing effect with this radiation pyrometrical test it would give a wrong reading. The rays must be parallel. If there is any tendency to converge or to focus it would affect the reading.

MR. BUTTERWORTH:—In the conclusions drawn from his heat balance, Mr. Baehr calls attention to the desirability of having wide furnaces and a large grate area. In that connection it might be interesting to state that at Denver we have 20 benches, 10 of which have wide furnaces and 10 of which have narrow furnaces. The narrow furnaces being but a little more than one-half as wide as the wider furnaces. With the same character of coal exactly we have to clinker the narrow furnaces four or five times as often as we do the wider ones.

MR. PERSONS:—I move that a vote of thanks be extended to Mr. Baehr for the preparation of his valuable paper, and also a vote of thanks to Mr. Doherty for reading the paper and for the suggestions made by him in the discussion if it. (Seconded, adopted.)

PRESIDENT ANDREWS:—We will now take up the paper by F. W. Stone, of Ashtabula, on the subject of

NATURAL GAS AS A FACTOR IN THE ARTIFICIAL GAS BUSINESS.

F. W. STONE.

That natural gas is a factor in the artificial gas business in some sections of this country, especially in Ohio, must be evident even to the most casual observer. At the present time in Ohio over 50 per cent. of the artificial gas plants are either having natural gas as a competitor or else are being changed to natural gas plants. In some cases the competition of natural gas has been so strong that the artificial gas plants have been abandoned.

When I say that over 50 per cent. of the artificial gas plants in Ohio consider natural gas as a very potent factor in their business I do not tell all of the truth, for this 50 per cent. includes almost all of the larger cities and towns, the writer being able to think of only six cities of over 10,000 inhabitants in this state where natural gas is not used.

It also must seem that natural gas has been somewhat of a factor in fixing the prices of artificial gas, as it would appear to be more than a coincidence that in the regions where natural gas is the most used, the average price of artificial gas is the lowest.

There are those of us who have been in the artificial gas business when threatened by natural gas competition and have realized how useless it was to fight. Welsbach lamps are cheap and natural gas will give as good a light in one as artificial gas and this with natural gas at 25 cents and artificial gas at $1, or less than one-fourth the cost. For cooking and heating purposes natural gas has the same relative advantages.

In all these ways natural gas has apparently been a factor adverse to the artificial gas business, but this is only one side of the case.

I believe that the use of natural gas has helped the artificial gas business by helping the sale of fuel gas appliances. People in towns not favored by natural gas heard of its use, gas was gas to them, one kind the same as another. They wanted it and made a demand for it. The manager for an artificial gas plant said to himself that if there were appliances adopted for its use he could sell gas for fuel just as well as the other fellow. The appliances were made and the demand of the public met.

The natural gas business has also undoubtedly taught the artificial gas manager the value of selling a large quantity of gas at a low price.

We have also learned from our natural gas brethren the usefulness of distributing gas through high-pressure lines to the point where the demand is the greatest and there reducing the pressure to meet the local needs.

But it is in the future that natural gas will play the most important part in the development of the artificial gas business. The manager of every artificial gas plant that is having natural gas competition or has changed over from artificial gas to natural gas is thinking of the time when natural gas shall be exhausted. That the public generally believe that within a few years this may be the case is evidenced by the fact that in almost all of the fran-

chises that have recently been granted there is a clause allowing the company to supply artificial fuel gas should the supply of natural gas become exhausted.

Think of the plant and the demand then. A town of 10,000 inhabitants, thoroughly piped for natural gas should have about 25 miles of mains, about 2,500 customers and sell about 350,000,000 feet of gas a year. The daily output, however, will vary from over 2,000,000 feet a day in the winter time to 100,000 feet on a summer day. In fact, on two consecutive days in the winter the output may vary 1,000,000 feet.

Of course if a man were to change to artificial gas he would not keep all of this trade, yet if by some unknown hook or crook he could sell an artificial gas containing about 650 heat units for 50 cents per 1,000 cubic feet he could probably keep about one-third of it and the part he would lose would be that which had caused the greatest variation in his output.

From what I know of the fuel business I have no doubt but that under the conditions stated, and with proper appliances all of the cooking, all of the office heating and a fair portion of the heating of dwellings could be done with artificial gas. There has been current in the land an idea that there was a great difference between the sale and distribution of natural and artificial gas, but I cannot see that there should be any great difference. Of course you distribute natural gas at a higher pressure, and must be prepared to meet greater variations in output. In the beginning of the natural gas business there were no devices by which it could be used successfully for light, and its low price made that field undesired by the manager as there was no money in it. On the other hand there were no appliances by which artificial gas could be used as fuel. Both conditions have been met and the price of natural gas is going up and that of artificial gas going down. It will not be long until the managers of both artificial and natural gas plants will use the same methods for getting and retaining business.

I predict that, spurred on by the demand for fuel gas, gas engineers will, in the near future, find a way to make gas cheaply in large quantities.

That the gas-works of the future will be built more with a view to the product of a fuel gas rather than a gas for light.

That it will be built to meet a varying demand.

That the gas will be pumped through high-pressure lines to various points of distribution where the pressure will be reduced.

DISCUSSION.

THE PRESIDENT:—Gentlemen, you have heard an extremely valuable paper on a very interesting subject, and I trust all of you will join in a full and further discussion of the features brought out by the author. I will call on Mr. Persons to open the discussion, as I believe he has had some little experience in Toledo in regard to natural gas as a factor in the artificial gas business.

MR. PERSONS:—My experience has been entirely with artificial gas. I have flirted a little bit, possibly, with natural gas, but I have never had any intention of going into the natural gas business. I am not in the business and have no intention of going into it. We have had a little experience in Toledo in selling gas appliances where we have had natural gas at 30 cents per 1,000. We have artificial fuel gas there at 70 cents per 1,000. From the fact that natural gas appliances came into more general use by reason of the utilization of natural gas we have been able to do quite a large business in selling stoves for artificial gas. We have sold a good many, and we found that they stayed. Of course, it is fair to say that probably a large majority of our stoves are sold on lines where natural gas had been available, but where it had been taken from that section of the city. We have sold a great many there. Our gas stove business has increased something like 40 per cent. the last year. It is a pretty hard blow for a manufacturing company to have natural gas drop down on it. You cannot help but feel it at first. But from the little experience I have had I am led to believe that we are going to have natural gas throughout this state for a good many years to come. None of us now hope for natural gas to disappear within a very short time, because new fields are being opened, and these new fields have proved to be the best fields that have ever been in the market, so that you must prepare for a good long fight if it comes to your town.

JAMES T. LYNN:—I have had some little experience with natural gas. I am interested in natural gas in Ohio to-day, and in artificial gas as well. Last fall they brought natural gas to northern Ohio into three towns where I was interested. When natural gas was brought into a town in which I was interested I sold out to the natural gas company and got out of the town. I am interested in a little natural gas company over here at Bowling Green, O., a town of about 5,000 people . Last year we sold at Bowling Green 127,000,000 cubic feet of natural gas to 5,000 people. I may say that the natural gas business in the state of Ohio

to-day is in better condition that it ever was. I do not think we will have natural gas out of Ohio for 25 years to come. I am speaking now not of the smaller places, because I think they are taking on a great many small towns which they will eventnally drop off. They have struck the best fields in West Virginia that have ever been struck in the natural gas business, and they are now selling natural gas on a different basis than they have ever done in the past. Ten years ago, and even five years ago, everything in Ohio was sold on a mixer basis, outside of the city of Toledo, paying $1.50 per mixer, or $2, or whatever the rate might be. To-day everything is on a meter basis, and natural gas companies are getting paid for every foot of gas they are furnishing to their consumers, so that natural gas will last very much longer in this way than under the other form. Outside of Chillicothe and Circleville, and two or three other smaller towns, natural gas in Ohio is sold altogether now by meter. Some of these smaller towns this last winter went cold a good many days. But by selling the gas on a meter basis the supply will last much longer. I think that natural gas will eventually be a benefit to the artificial gas business in Ohio. I do not believe it will benefit the present generation of artificial gas men very much. I think, however, that natural gas is here to stay for a good many years. In a small town in Northern Ohio, where they have used natural gas for about five years, we bought the plants and built an artificial gas-works. During the life of natural gas in this town they sold about 85,000,000 cubic feet per year. After the artificial plant was erected we sold 9,000,000 cubic feet, and last year, after four years' labor, we were up to 15,000,000 or 16,000,000 cubic feet. My advice to all gas companies is, if they are going to have natural gas competition, to either buy it from the natural gas companies at the city limits and distribute it through their artificial gas system, or, if possible, sell the existing plant to the natural gas company.

MR. COOMBS:—I would like to ask Mr. Persons if they have good natural gas service?

MR. PERSONS:—The best in the world. This winter, for about 24 hours, the pressure was a little low on account of the temperature, but only for about 24 hours. We got along all right with that exception.

MR. COOMBS:—I would like to ask Mr. Persons what inducement he offers to consumers to use artificial gas at 70 cents per 1,000, as against natural gas at 30 cents.

Mr. Persons:—When natural gas was first installed they usually, for domestic purposes, installed it in the cheapest way possible, as for instance, putting in an ordinary perforated burner and a piece of gas pipe, which lost its efficiency in a very short time, warped out of shape, began to leak and lost its usefulness. By offering a first-class modern gas stove you can show about the same results with artificial gas at 70 cents that you can with natural gas at 30 cents for domestic purposes, and by reason of the increased flame temperature of artificial gas over natural gas due to good burners, and by properly utilizing the other advantages of artificial gas over natural gas we have been able to accomplish the results referred to. Good soliciting is also an important factor. We tried advertising, which did us some good possibly, but our stoves were all sold by personal solicitation, good hard knocking every day in the year.

L. T. Palmer:—I would like to ask if anybody here has had any experience in the competing of natural gas with manufactured gas when both are supplied by the same company?

Mr. Cline:—I would suggest that you furnish illuminating gas for illuminating purposes and natural gas for fuel purposes. That is the way we disposed of that question at Springfield, O. Natural gas we sell at 25 cents a 1,000 and illuminating gas at $1.25 a 1,000. We operate under a peculiar ordinance. The ordinance for natural gas provided that it should be sold for fuel or for power purposes only and we thought in that way we would keep the people from using it for illuminating purposes. We did not altogether accomplish that. Quite a number of consumers use it for both purposes.

Mr. Lynn:—I have had some experience in distributing both natural and artificial gas in the same city, the city of Detroit. We used to run a natural gas plant and also an artificial gas plant. We tried as far as possible as Mr. Cline said to keep the people from using natural gas for illuminating purposes and where we would find them using it for both purposes, we would try to bluff them into paying $1 per 1,000 for the natural gas consumed for illuminating purposes. However, the courts have rendered two or three decisions on that subject to the effect that gas companies cannot control the gas after it passes the meter. After it passes the meter the consumer can use it for whatever he wants to use it regardless of any contract or anything else we may have with him. When it passes the meter it is charged to

him, it is his, and he can use it for heating, cooking or illuminating purposes, just as he sees fit. While I had charge of the distribution of natural and artificial gas at Detroit, in a quiet way we would vary our pressure in the evening so that if a person was trying to use natural gas for illuminating purposes he would not be able to get any satisfaction from it at all. He would have a light one minute and the next minute would find himself in semi-darkness. We could do that after dark because the fuel business was practically shut off. Of course in a city like Cincinnati, or Detroit, or Toledo, or Cleveland or any of the larger cities, I think there is a place for the artificial gas regardless of the supply of natural gas. However even in these larger cities their income is going to be cut down and their earnings very materially reduced by the introduction of natural gas. As Mr. Persons explained, 10 years ago, when natural gas was introduced, people who were using natural gas were using it in appliances of a temporary character, as for example, in an ordinary cook stove with a gas pipe stuck in for a burner and so on. They were using natural gas just as they would burn coal, and consequently they had to heat up the entire stove to make a cup of tea. The gas that is in Ohio to-day is a different gas from the gas we use in Detroit and also the gas that was used in Toledo. The gas from the Findlay district comes from the Trenton rock and has about one-seventh of 1 per cent. of sulphur in it. But the present gas in the southern and central part of Ohio comes from the Clinton rock and that has scarcely any odor at all about it. You can turn it right into your artificial gas mains and use it in that way without any waste at all. It will burn just as nicely as artificial gas.

THE PRESIDENT:—I will call upon Mr. Light, of Dayton, who has had quite a long experience with natural gas and who has been very successful in his management of the situation.

JOSEPH LIGHT:—I do not know very much about natural gas. I know when they first talked about bringing it to Dayton, our President and myself had a conference about it, and I made this remark, that if it is coming to Dayton, it is not coming to stay. I said that it was unreasonable to suppose that it was going to last forever, and the sooner we have it here the sooner we will get rid of it. The result will be in the end that the people will be educated for our benefit. I think we have arrived at that point now. This winter we have been very busy. Some days we have not

had as much natural gas as would cook an egg, and it ran that way from about 10 o'clock in the morning until about 10 o'clock at night. About 10 o'clock at night the pressure began to increase. It would increase until about 6 o'clock in the morning, and then it began reducing again and by 10 o'clock it was all gone. It has not affected us as badly as it has artificial business in some other places. We have been able to hold our own very nicely so far against natural gas. We have gone back but very little. We have shown a gradual increase. It was only for a little while that we were put back, and we have had a very satisfactory gradual increase right along. This winter it has been a very large increase; so much so that it has put us to an extra effort to supply the demand.

CHARLES S. RITTER:—Mr. President, I have had some experience with natural gas in two different places, first at Columbus, O., and then at Detroit, where I am now located. We shut off natural gas a year ago last August. I have no figures here so as to be able to give you just the relative value of the education which the people got in Detroit by virtue of having used natural gas. I think, however, that Mr. Stone is a little bit optimistic in stating the percentage of consumers he will be able to retain when natural gas fails. We have retained practically all of our power gas, our gas engines, but I should say that for other industrial purposes we have lost a great deal. From our experience in Detroit I cannot help but feel that Mr. Stone's estimate is rather high.

MR. STONE:—I am, at the present time, running a natural gas plant, and I have not got far enough along to worry over the supply of artificial gas in case of emergency. Having run an artificial gas plant and afterwards changed over to a natural gas plant I simply was comparing the two and stating the conditions on which a fuel-gas plant would have to be operated. I do not believe there is any system known in gas literature to-day that fully fills the conditions that would be necessary for a fuel-gas plant. I do not believe there is any system that is economical enough and which allows you to use everything that you produce and at the same time will give you the variation in output that would be necessary for a proper working of it in order to supply all of the demands made under all conditions. I am speaking now with reference to what you might call strictly a fuel-gas plant, and that is simply my own personal opinion. But I have faith

enough in the gas business, and I have faith enough in gas engineers to think that when the demand comes for it a solution for that problem will be worked out. I believe that the gas engineers will find a way to do it. Mr. Ritter has stated he thought my estimate of the amount of gas that would be used in case we went back to artificial gas was rather optimistic. Well, I dont' think so. I do not think so because I qualified the statement by saying that in case the proper appliances were used, and in case the business was handled in the right way then the estimate which I made would hold; otherwise not. It is foolish for you to try to induce people to use things, the use of which will prove unreasonably expensive to them. If you do not put in proper appliances, and if you do not fix your distribution system right you make it expensive for people to use it and then they talk to their neighbors, saying: "I tried to use gas for cooking," or, "I tried to use gas for heating, but it was not any good. I find that it costs me too much." I based my estimate on the use of the gas by the installment of proper gas appliances constructed with a view toward the economical use of the gas. I notice that in comparing the figures at Ashtabula with the figures prevailing in some of the other towns using natural gas that our bills at Ashta bula average only about 60 per cent. as much as in some of the older natural gas towns. The average meter bill for domestic consumption in some of the older natural gas towns worried me a little bit. We like to sell as much gas as we can, and have the people satisfied with it, and I made it a point to take the accounts from two or three towns and analyze them, and I found it was not because we were selling to any more people, or it wasn't because we were not selling them for the same purposes that they were in these other towns, but simply because the people of Ashtabula, prior to the advent of natural gas, had been educated to put in the most economical appliances they could put in. They had been educated to utilize it in the best manner. They had been educated to be careful of it, and to exercise care and economy in its use. That education has been to a certain extent a bad thing for me, because by reason of it I am not selling the quantity of gas per meter that I feel I would like to sell. But, on the other hand, if I should ever have to change back to artificial gas and sell it again I really believe that I could still hold at least from one-third to one-half of the business I have now got using natural gas. I have analyzed the accounts and I have figured out that these people

cannot afford to get along without it. That has been my experience in the town of Ashtabula in the use, both of artificial and of natural gas, and the result of my comparison between the two, and my comparison between our experiences in Ashtabula and the experiences in other towns of about the same size, where natural gas is also used.

JOHN D. MCILHENNY:—I have had no experience in the natural gas business, but I have had some experience with a gas company where the price of gas has been increased. In a certain town, two gas companies were competing with each other and selling gas at 50 cents per 1,000, and in some cases, a special reduction was allowed under that price. The companies were combined and the price of gas increased to an average of a trifle over 80 cents per 1,000 cubic feet. The first year the company lost a consumption of slightly over 20 per cent. in gross sales. In a little over three years, they had regained that 20 per cent. and the company is still going ahead having a very satisfactory increase of business. It has been said that while competition is very much to be deplored and very bad in many ways, still it seems to have one ameliorating feature in that it induces the public to burn gas more freely and in no other way will they reach that point except by long continued work and persistent effort. It has been shown where gas has been sold at a low price and then increased, the consumption has practically been retained for a year or two years' time.

MR. LYNN:—I have had some experience in a small town where I am interested in the gas business, and where the same conditions existed as are referred to by Mr. McIlhenny. We bought out two companies who were competing. They were selling gas as low as 45 cents for fuel and 80 cents for light, and when we consolidated the two interests we increased the price to 80 cents for fuel and $1.25 for light. That has been five years ago next month. At that time, in a town of 15,000 to 18,000 people, we were sending out 18,000,000 cubic feet. Last year we sold 62,000,000 cubic feet in the same town. But the opposition company, by selling gas at a cheap price, started the sale of gas appliances in that town and educated the people to the use of gas for fuel, both for heating and cooking. When I and my associates purchased these plants, I wrote to Mr. McIlhenny, knowing that he had had the same experience in this town that he speaks of, asking him what the decrease was from the increase in price. Our

decrease the first year was less than 10 per cent. on the increased price. Of course in these five years we have extended the mains very materially and reached a great deal larger consumption and a larger population than we did before. The town I speak of, at the last census had a population of about 18,000 people and there are probably 20,000 to 21,000 people in the town to-day.

MR. DOHERTY:—There is one subject I do not want to see passed over. I do not believe that you could sell gas for heating purposes only at $1 a 1,000 to take the place of coal for domestic heating, and make it pay.

MR. PERSONS:—I think Mr. Chollar made a statement some years ago at some convention, in some paper, that ordinary artificial gas for domestic heating purposes at $1 would be equivalent to coal at $40 per ton.

MR. DOHERTY:—I did not make my remark quite plain. I meant if you could sell the gas at $1 per 1,000 for heating purposes. I doubt if the company made money out of it if it only took the place of coal for domestic heating. It is a problem that is, I think, beyond the engineer. If some one were to give me gas free at atmospheric pressure, I could not afford to distribute it, and compress it and sell it in competition with coal at Denver. That is due not to the low price of coal there, but due to the peculiar conditions existing at that point. We have about two weeks in each year when we have extremely cold weather. The thermometer will go down, we will say, to 20 degrees below zero. As this happens only about two weeks out of the year, the houses are not built and thoroughly protected against cold as they are in St. Paul, where they have cold weather all the year round. The low factor of our plant in Denver to-day is about 16⅔ per cent. By low factor, I mean we have to have a works and a distributing system—the distributing system is the important part of it—capable of distributing 225,000 feet of gas per hour. Now, if we distribute at that rate throughout the entire 365 days of the year, or, rather, throughout the 8,760 hours of the year, our output of gas would be six times what it is. Taking a temperature diagram and figuring the amount of gas in proportion to the difference of temperature, we would have to have a works and a distributing system 25 times as big as the total amount of gas we would sell, and a large portion of the year it would be lying idle. Now, the lowest cost for gas of course will obtain when we can work all of our investment to its full capacity, and if you work it at a less

and less amount of capacity you finally get to that point where the fixed charges eat you up. The solution of the problem, I think, rests with the system of charging and not with the method of selling gas. When we say we will sell gas at so much per 1,000 cubic feet and agree to supply the demand, no matter what it may be, it would be a good deal like some one coming to this hotel and saying: "I want to engage 100 rooms. I don't want to permit anybody to use those rooms but myself, and when I occupy any of those rooms, or all of them, I will pay you so much per night." What rate could the proprietor afford to give that man? If he occupied one room for one night in the year you would have to charge him like the dickens for that one room, occupied one night, to come out even, but if he occupied all of those rooms 365 days of the year, you could give him a very low rate. In other words, the rate per room in the illustration, or the rate per 1,000 of gas consumed in our case, is an absolutely inequitable method, and we can never develop our business to its logical possibilities as long as we sell gas per 1,000 feet for distribution, no more than in the electrical business, if the electrical energy is sold on the basis of so much per kilowatt-hour basis. I do not believe to-day 50 per cent. of the electrical companies in the country are still sticking to the per kilowatt-hour basis, but they are using a differential basis on the low factor of the particular consumer, and I believe we will come to some such basis in the gas business. At first blush a gas man may turn up his nose at such suggestion, but the more he thinks about it, and the more frequently a problem like that is given to him I think he will finally find that he is selling something besides gas; that he is selling a convenience, and that when he gets a consumer he is giving him the freedom to use a portion of the investment which is costing the company money all the time, and the company must get a return on that portion of the investment regardless of how much gas the consumer may burn.

It was then moved by Mr. Lynn, duly seconded and carried, that a vote of thanks be tendered to F. W. Stone for his very valuable and interesting paper.

President Andrews:—Mr. Doherty, I understand, has some announcement to make in regard to the question box.

Mr. Doherty:—The question box contains about 160 questions. All of them have not been answered, but a great many of them have. Seventy-three engineers and managers throughout

the country have contributed to this question box. Now it is impossible to take up all of these questions and discuss them on the floor of the convention. The idea being that this would simply be a contribution to gas literature. A portion of the questions in this question box, however, can and should be discussed. I therefore make the suggestion that each member interested look through the question box during the noon adjournment and then this afternoon name such questions as he would like to have discussed here in the order of preference. Then by a little clerical work we can ascertain which questions a majority of the members wish discussed. Pass the slips to the Secretary containing your choice so that we can determine which ones you want to hear discussed and which ones have the preference.

On motion, duly seconded, the Association then adjourned until 2 P. M. of the same day.

First Day.—Afternoon Session.

The Association met at 2 P. M.

President Andrews:—While waiting for the members to vote upon the question box, we will take up the "Progress Department," as edited by Irvin Butterworth.

PROGRESS DEPARTMENT.

IRVIN BUTTERWORTH, EDITOR.

In accordance with the recommendation of your President for last year that one of our members be designated to prepare, for presentation at this meeting, a summary of the progress and improvements that have been made in the gas business during the past five years, I was duly appointed to undertake such task, and herewith respectfully submit my report, which, while necessarily meager in its treatment of many important matters, and doubtless omitting others altogether (so extensive was the ground to be covered), I have still endeavored to make it as nearly complete as the limits of a report suitable for this occasion would seem to permit. It will be obvious, however, that but scant justice has been done to my subject under the circumstances; but if this feature of your Association work is to be continued these reports will hereafter cover only the previous year's progress, and should

therefore be much more easily made satisfactory. In order to lighten the work of my successor I take the liberty to here request all gas apparatus manufacturers and others who may read this report to advise your "Progress" editor for the coming year of any misstatements or omissions which they may discover in this report, in order that he may correct same, as no one man can, without such assistance, prepare a complete and correct report.

The following *resume* will prove a source of encouragement to any who feel that progress has been slow and invention indolent during the recent history of the gas business. There has been more or less advancement all along the line, touching practically every detail of the business, the aggregate effect of which has been to greatly increase the practical efficiency of our plants and methods.

My treatment of this subject will be confined to the practical and mechanical features of gas manufacture, distribution and consumption, not touching upon business conditions and policies or commercial results.

APPLIANCES.

Gas Engines.—Undoubtedly the greatest progress that has been made in the gas business during the past five years has been in the direction of the development and use of the gas engine.

When using coal-gas the best modern large gas engines will consume only about 15 feet of gas per hour per horse-power as against about 20 feet five years ago, while when using producer gas a horse-power per hour can now be obtained from 1 pound of coal, or less than one-half the quantity employed by the best steam engines, and as high as 34 per cent. of the theoretical heat value of the fuel can now be transmitted as power to the engine shaft. The regulation of gas engines has been improved to such a degree that a cyclic variation of 1/350 is now obtainable, easily permitting the operation by them of alternating current generators of medium frequency in parallel, something that has not heretofore been possible. This has been accomplished:

(1) By varying the quantity of the explosive mixture in proportion to the changes of load without changing its strength per unit volume and without decreasing the number of charges per unit of time, instead of, as heretofore, simply varying the number of explosions in proportion to the changes of load; and

(2) By substituting for the old-fashioned single-acting cylinder two or three, or even more cylinders, set eccentric, then making the cylinders double-acting, so that the engine shaft now receives much more frequent impulses than formerly.

Electric igniters have been substituted for the hot-air tube permitting more exact and economical timing of the moment of ignition.

Compressed air is now used for starting the engines, removing a former difficulty, and large gas engines are now being built for lean gases such as producer and blast-furnace gases. Their dependableness has been increased to such a degree that recently a 150-horse-power gas engine was operated at nearly full load, night and day, for 138 days without once stopping. According to our last census the number of gas engines in use in the United States in 1900 was 14,884, although this return is probably far from complete, while according to the same authority the aggregate horse-power of these engines was 143,850, being 1,500 per cent. more than in 1890, this being the largest increase shown in the use of any prime mover. But the most astonishing increase has been in the size of the engines. In 1893 visitors at the World's Columbian Exposition in Chicago were impressed with the 35-horse-power gas engine there exhibited. At the World's Fair in Paris, in 1900, a 1,000-horse-power gas engine seemed a monster, but within the past two years sizes have been increased to as high as 4,000 horse-power, and the British Westinghouse Company is now building at Manchester, England, 1,500 horse-power two-cylinder gas engines.

America seems to be lagging behind Europe in the matter of the number of large gas engines in use, only 25 per cent. being placed to our credit, although we have built as large as any that are in use thus far (4,000 horse-power), and one American firm has recently taken contracts to build 16 gas engines of 2,000 horse-power each. In Europe the use of large gas engines with producer gas for operating factories has increased enormously within the past two years, one firm having made 32 engines averaging 1,390 horse-power, none of them less than 200 horse-power. The present tendency is toward the horizontal type of engine, but Herbert A. Humphrey, who is a student of this subject, predicts that the vertical type will finally prevail, especially for central station work. Although most of these large engines are used, as stated with producer gas, yet 280-horse-power gas engines are

used in this country with ordinary illuminating gas. Mr. Humphrey says: "The recent remarkable progress in large gas engines will undoubtedly continue until Sir Frederick Bramwell's prophecy of 21 years ago has been fulfilled and steam engines will only be found in museums."

Gas Ranges.—I have no statistics showing the increase in the use of gas ranges during the past five years, but it is a matter of common knowledge that their use is increasing enormously. I estimate that there are now about 1,500,000 gas ranges in use in the United States. This is on the basis of 1 to every 20 inhabitants in the cities and towns supplied with gas.

While no one improvement of a radical nature has been made in gas range construction during the past five years yet many minor improvements have been made that have greatly increased their efficiency, durability, adaptability, appearance and convenience. Among these many improvements are the following:

(1) The bodies (sides, backs and fronts) were formerly made of common sheet steel; now they are made of blue polished and planished steel, which does not burn or chip off.

(2) The ovens are larger than formerly and are now made in standard sizes, conforming to standard sizes of tinware.

(3) Heavy castings were formerly used for bottom and top oven plates, which had to be heated before any cooking could be done; now oven linings are made of two sheets of metal with an air space between them, the outer plates being further reinforced with asbestos, thus reducing radiation, and by these means, and by properly ventilating the ovens (which was not formerly done) and a proper handling of the products of combustion, it now requires, according to one authority, only from 3.5 to 5 feet of gas to heat the ovens to a baking temperature as against 18 to 24 feet a few years ago.

(4) Ranges formerly rested directly upon the floor; most of them are now supported by short legs so that the floor underneath can be kept clean and is protected from charring, while others are provided with a sub-base that prevents charring and the accumulation of dirt.

(5) The old-fashioned sawed or slot burners that were subject to warping and stoppages have been replaced for the most part by drilled burners, the top burners being generally star-shaped, thus bringing the heat nearer the center of the cooking vessel, reducing to a minimum the cold center under same and forcing the heat to pass over the greatest possible area of the bottom of the vessel.

(6) Top burners are now more economically located with reference to their distance from the bottom of the cooking vessel, and the top of the stove is left more open for the rapid escape of the products of combustion, thus preventing the smothering and imperfect combustion that formerly sometimes occurred.

(7) Top burners are now made in one piece, preventing leakages and allowing the unobstructed passage of the gas, and each burner is easily removable separately without unscrewing any bolts.

(8) Formerly in order to repair or replace an oven lining the entire stove had to be practically dismounted, but now the sides, ends, tops and bottoms of ovens are made by dies instead of by hand, rendering them interchangeable, so that the oven linings can be easily and quickly removed and replaced without disturbing the body of the stove.

(9) Valves operated by wheels or knobs have given way, for the most part, to lever-cock valves, which always indicate at a glance whether they are open or shut, and which can be easily tightened when loose by turning a screw.

(10) Burner orifices are now much more easily adjusted than formerly to different gases and pressures.

(11). There have been many minor improvements, such as less fancy work, wooden valve-handles, drip-pans so made that fluids spilled or boiling over will not run down the sides of the stove, wire instead of cast-iron oven racks, gas supply-pipe extra heavy, giving more threads for gas-cocks, etc.

(12) Ranges formerly carried first-class frieght rates; now they carry only third or fifth-class rates, meaning a large saving to the gas companies.

Progress has also been made in large baking ovens, especially as to their capacity, one having recently been installed in Boston that is 18 feet long, 11.25 feet wide and 5 feet deep, having a capacity for baking 32,000 1-pound loaves of bread every 24 hours at an estimated cost for gas of 0.1 of a cent per loaf.

Gas Heaters.—There have been, during the past five years, no improvements in portable artificial gas heaters worth mentioning, essentially the same types and designs having been used throughout the period. There have been some improvements in natural gas heaters, but as they contemplate the use of large quantities of cheap gas they need not be considered here. Several years ago one enterprising firm brought out a large hot-air gas furnace

for heating entire houses from the cellar, but as it cost about 2.5 times as much to heat a house with it as to heat it with coal, notwithstanding it is said to utilize 80 per cent. of the heat units of the gas, its use has not become extensive. The same firm has since gotten out a large water-heater adapted to house heating which is said to give good results. In Milwaukee, Mr. Walker has devised and put into use a gas furnace for heating houses with hot water that serves the purpose very satisfactorily during cool fall and spring weather, and that should have even a greater field in more southern cities.

Independent Water-heaters.— Considerable improvement has been made in the construction of water-heaters during the past five years, resulting in a great increase in their efficiency and general satisfactoriness. The water-heater attachment to gas ranges of former times, which was very uneconomical, has given way entirely to the independent heater, and these are now made lighter in weight, with thin and contracted water passages, rendering them very efficient and practically instantaneous. Illustrating the improvement that has been made in them, one firm reports that the heater they formerly made required 83 minutes to do the work that their present heater accomplishes under similar conditions in 40 minutes. Five years ago water-heaters were constructed with tight casings and burners so that in order to get at the coil or burner it was necessary to disconnect the heater from the boiler. Now they are so constructed that the entire casing can be easily and quickly removed for the cleaning or repairing of the coils and burners without disconnecting either the water or the gas connections. Some manufacturers are avoiding the leakages and stoppages due to a multiplicity of small water pipes and numerous joints by using instead cast-iron sections of various forms placed one above another, and one is employing a spiral form of water chamber for accomplishing the same purpose. In fact, there is at present great activity in invention looking to the improvement of water-heaters, and one firm boasts a flue-gas temperature of only 240 degrees, indicating, under proper conditions, a high efficiency.

Instantaneous Water-heaters.— There has been some progress made in the development of instantaneous water-heaters, chiefly in making them of different sizes for different purposes, and in so constructing them that the water comes in actual contact with the products of combustion, increasing their efficiency to the extent that the water absorbs as high as 90 per cent. of the heat of the

gas. One heater turns out 3 gallons of water per minute, raised 50 degrees in temperature, with a consumption of from 2 to 2.5 feet of gas. But the use of these heaters seems to be as yet somewhat limited, possibly partly on account of their necessarily high price. The independent water-heater business seems to be growing much more rapidly. A concern employing 100 men now turns out, according to their own statement, the bulk of the instantaneous water-heaters that are used in this country, but as they employed only from 10 to 20 men four years ago, the growth of their business is evidently very considerable.

Industrial Fuel-gas Appliances.—Much progress has been made during the past five years in devising and perfecting numerous fuel-gas appliances for industrial purposes and in developing the use of same, but the limits of this paper preclude an enumeration of them in detail. Perhaps an idea can best be obtained of the progress that has been made in this direction from an examination of the following list of purposes to which artificial gas is now being applied more or less extensively in this country, for hardly any of which it was used five years ago:

Babbitt metal melters,
Ladle furnaces,
Keg and other branding,
Gas furnaces,
Brazing furnaces,
Assay furnaces,
Crucible furnaces,
Water stills,
Drug stills,
Annealing furnaces,
Hot-soda fountains,
Can soldering machines,
Singeing machines,
Hat shapers,
Shampoo dryers,
Corset bust block heaters,
Clothes sprayers,
Heating incubators,
Polishing leather,
Embossing leather,
Re-sweating tobacco,
Vulcanizing rubber,
Welding,
Heating glue,
Heating tools,
Smelting,
Tire setting (vehicle and locomotive),
Heating glass moulds,
Tempering,
Beer vat dreyers,
Gas laundry mangles,
Pleating and crimping rolls,
Hard oil melters,
Rendering kettles,
Dental furnaces,
Multiple burners,
Clothes dryers,
Cigar branding machines,
Shoe burnishing machines,
Band shrinking,
Case hardening,
Carbonizing electric burners,
Capsule making,
Chafing dishes,
Dry hot-air baths,

Rod heating,
Hulling beans,
Hot-air lamps,
Hair dryers,
Muffle furnaces,
Pure food manufacture,
Burnishing photographs,
Night lunch wagons,
Photographic plate dryers,
Stamping names in hats,
Heating wax,
Heating rivets,
Heating metal plates,

Of course special appliances have been devised for using gas for each of these purposes. The Milwaukee Gas Company has probably done more in this direction that any other company in the country. The paper of their Mr. Walker, read at the meeting of the Wisconsin Gas Association last month, gives an inkling of the cultivation that has been given the use of gas for industrial purposes. They are now able, for instance, to melt brass cheaper with gas than with coal, and have devised furnaces for such purposes that consume as much as 420 feet of gas per hour.

The progress that has been made in the use of gas for fuel purposes is well shown in the fact that many gas companies in this country are now selling, during the year, quite as much gas for fuel purposes as for illuminating purposes.

LAMPS, BURNERS, ETC.

Welsbach Burners.—There have been no radical improvements in the Welsbach burner itself, but many minor ones, such as:

(1) Improvement in the adjustable check originally brought out in 1897.

(2) The invention of a new check by which a needle-valve is operated by means of a milled screw-head at the side of the burner base. A ball-check burner has also recently been put upon the market.

(3) The strengthening of the gallery.

(4) The shortening of the Bunsen tube, improving the appearance of the burner.

(5) The devising of a single burner that is adapted to any standard mantle, any kind of gas fixture, any design of glassware, any pressure of gas, and for use, if desired, with open-flame gas globes.

(6) The designing of porch burners capable of withstanding draughts.

There has also been devised a ball joint that makes the fixtures always hang plumb. Improvements have also been made in anti-vibrator attachments and in pilot lights, the newest pilot light being said to consume less than 1 foot of gas per 24 hours.

Incandescent Gas Mantles.— While there have been some improvements in the manufacture of gas mantles during the five years, none of them have been of a radical or important nature, except, possibly, the carrier or cap attachment invented several years ago, and now so perfected that any consumer, however unskilful, can easily place and adjust his mantle on his burner, and which also protects the mantle from breakage in shipment and handling. One manufacturer makes a central support for mantles, claimed to conduce to their longevity; another has adopted a new stitch that is claimed to do the same thing. The larger manufacturers are turning out mantles much more uniform in quality than formerly, and the greenish cast of light originally emitted by them has been overcome, the light now being of a pleasing quality. The best mantles now give a light of about 21 or 22 candles per foot of gas at ordinary pressure, which shows no perceptible improvement in this respect during the period under consideration. Mantles are now made in much larger variety than formerly for a greater variety of purposes, the latest catalogue of one manufacturer displaying 26 different kinds of mantles. The price of good mantles has not been materially cheapened in this country, but their use has increased enormously, at the rate, according to one authority, of 3,000,00 per day during the past five years, until now it is estimated that 30,000,000 per year are manufactured and used in this country.

Arc Gas Lamps.—There have been great improvements in incandescent gas burners, particularly in the recent development of the so-called "arc" gas lamps and in the still more recent high-pressure and self-intensifying gas lamps. Of the former there are said to have been 130,000 manufactured and put into use by one firm alone in this country during the past two or three years. In fact, the development of the "arc" gas lamp is considered by many gas men to be the most important step in the progress of the gas business during the past three or four years. By this means alone the gas companies in some cities have virtually been able to maintain their prosperity. When first made, about four years ago, these lamps were simply two, four or more ordinary Welsbach burners grouped under one shade, or in one globe, but separated quite a

distance apart on short arms of a pendant; now they are clustered very compactly together so that the mantles are in close proximity to each other, thereby emitting a light that justifies their name of "arc." They are now so made that all of the burners, or all but one of them, as may be desired, can be turned off by a by-pass arrangement. Their appearance and design have been greatly improved during the past year or two and a large number of firms are now engaged in their manufacture, the advertisements of not less than 15 now appearing in the technical journals of this country. Means for lighting these lamps by electricity have been so improved that this system of illuminating large stores is now perfectly satisfactory. As originally constructed it was a difficult matter to clean and repair these lamps; now no chimneys are employed in the ordinary construction, and the mantles can be renewed and the globe cleaned without removing the globe.

Self-intensifying and High-pressure Lamps.—Although these lamps have not as yet cut much of a figure commercially, yet their possibilities, or rather their probabilities, are so great that their development, which has all been within the past few years, is a matter of great interest and importance to us. Their chief development thus far has been in England, where high-pressure lamps using Welsbach burners consuming gas at high pressure are being used to some extent for street lighting and other purposes. At the outset this high-pressure gas was produced by means outside of the lamp itself, but now lamps are being so made, as in the case of the Scott-Snell lamp, as to utilize the heat of the products of combustion for this purpose. The means for doing this are as yet cumbersome and noisy, consisting virtually of a miniature hot-air engine, militating against the rapid introduction of the lamps; but as the efficiency of the lamps under proper conditions is as high as 50 candles per foot of gas, inventive genius and industry, which is now very active along these lines, will probably soon bring them to a commercial success. A considerable number of these lamps are even now in use in New York and other cities of this country. There is also a type of lamp, such as the Lucas, which is made self-intensifying by means of an extremely long chimney, in some cases 4 feet long, that increases the draft and thereby intensifies the heat of the flame. These lamps are being vigorously and industriously experimented with and doubtless a commercial article will ultimately be evolved from them. At present they are quite unsightly. There is also

at present a revival of former efforts to perfect devices for mechanically mixing gas and air, in the known and exact proportions, before bringing the mixture to the burners, thereby greatly increasing the light per foot of gas consumed.

That during the past five years gas lamps have come into use that have increased the light-giving duty of a foot of gas from say 20 candles to 50 candles is a most significant and inspiring fact in its bearing upon the future of the gas business.

Incandescent Gas Street Lighting.—Incandescent gas street lighting has made great progress during the past five years, especially during the early part of this period, and it is still coming more and more into favor, gradually making headway against electric street lighting and regaining to gas much of this business that it had previously lost. Berlin, with its 32,000 Welsbach street lights, is now said to be the best lighted city in Europe. The growth of this system of street lighting is shown in the fact that in Boston and vicinity there are now in use about 15,000 incandescent street lamps, in greater New York and vicinity 20,000, in St. Louis 13,000, in San Francisco 5,000, etc., and nearly all of the smaller cities and towns of the country have many of them in use. The city of Liverpool owns an electric plant and buys what gas it uses from a private company, and yet the Chairman of its Lighting Committee, replying to a question asked in open council recently, said that the committee did not intend to extend electric lighting in the streets as they had found that incandescent gas was quite as good and much cheaper. The improvements in the lamps themselves during the past five years consist chiefly in the adoption of a more symmetrical and ornamental boulevard lamp with only two uprights, thus minimizing shadows, and having an irridescent dome that tends to reflect the light down upon the street, and improved ventilating arrangements, rendering the lamp wind, dust and insect proof. More of the bottom of the lamp is now being made of glass, lessening the shadows in the vicinity of the post. The burner itself has also been improved, as well as the pilot lighting arrangement. A clock-work device has also been invented for automatically turning out each lamp at any desired time.

Self-lighting and Electric Gas Lighting Devices.—There have been no noteworthy improvements in these devices, although some progress has been made. Chemical self-lighters, such as the platinum sponge pellet, have not proven commercially successful. Successful installations of electric gas lighting attachments for large

stores and for single lights are of course in use in considerable number, but on account of their relative expensiveness, unsightliness and unreliability, people who want self-lighting lights generally use electricity.

Gas Globes.—Five years ago Holophane globes were looked upon more or less as a scientific curiosity, the advantages and unity of which were not at first apparent to the average gas man. A leading gas journal at that time published the following prediction with reference to them: "Some day the public will awake to their real value and wonder at their long delay in doing so." This prediction has been verified, for we see them by thousands in every city, the finest gas-lighting effects being produced by them. The monthly sales of Holophane globes in this country are now said to be ten times what they were three years ago. The last catalogue of the Holophane Company illustrates 56 different designs of globes, embracing 95 different sizes, of which only a dozen were made five years ago. The improvements have been as follows:

(1) The weight of the glass and its liability to crack have been reduced.

(2) The maximum size of the globes has been increased to 20 inches in diameter.

(3) Rose glass shades are being successfully made for use with Welsbach burners, changing the harsh white light to a pleasing color.

(4) The globes have been made more refractory and more uniform in their results.

Gas Fixtures.—Some of the eastern fixture manufacturers have recently taken up the manufacture of high-class fixtures that are better than imported ones, including specialties in the way of single fixtures of intricate and elaborate design on a scale not attempted in this country five years ago.

Lava Tips.—Even lava tips are being gradually improved along the lines of greater accuracy and uniformity.

DISTRIBUTION.

Street Main Governors.— Automatic street main governors have been improved as follows:

(1) A safety or balance governor is now being placed ahead of the usual automatic governor for the purpose of delivering gas to the latter at a constant pressure, being usually that thrown by

the top lift of the holder alone. This enables the automatic governor to do its work much better than has heretofore been possible under the varying initial pressures due to the uncupping of three and four-life holders.

(2) Governors put on large outlets to new gas holders while the consumption from them is as yet small are now provided with temporary rings around the governor valves, restricting the openings so that small valves can be used; then when the consumption increases sufficiently these rings are removed and large and permanent valves are substituted. This does away with the old method of first installing a small sized governor and later a larger one.

(3) A glass vessel is now used for the mercury instead of iron for containing the mercury, enabling the operator to readily see what is going on.

(4) One chamber is now used for the mercury instead of three or four, as heretofore, and the mercury is adjusted to different heights by means of a movable displacement block, simplifying the governor and making it possible to properly adjust it the first night that it is put into use.

House Pressure Regulators.—With the tendency toward high-pressure gas distribution the individual pressure regulator for houses becomes even a more important device than heretofore. There are numerous makes upon the market and the best ones are being improved as the years go by, although no recent improvements have been radical or especially noteworthy. The valve mechanisms have been simplified and cheapened and the sensitiveness, durability and reliability of the governors have been increased. Most of these governors employ a metal float or leather diaphragm, to which is attached a vertical rod for actuating the valve. This rod is generally supported and held in position by passing through rather tight-fitting openings which are liable to stop up with naphthaline and other deposits thus impeding the movements of the rod and interfering with the proper working of the governor. Some concerns are now supporting this rod by means of chains and other anti-friction devices, thus permitting the openings through which the rod passes to be so large that they do not stop up. The leather diapragms formerly became dry and hard in time, as one side of them is necessarily exposed to the air, but one concern now keeps the diapragm submerged in oil, which obviates this difficulty. Governors are now made that

are very efficient, reliable and not liable to get out of order. One is reported that has been in constant use for four years without having required any attention whatever and is still as sensitive and as accurate as when first installed. This is probably an exceptional case.

Consumers' Meters.—During the period under consideration there have been no improvements in the ordinary house meter beyond the usual gradual perfecting of parts and of methods of manufacture that are bound to result in the lapse of time from the conscientious efforts of manufacturers to better even so perfect and time-honored a device as the justly respected gas meter. Many efforts have been made to depart with advantage from the Glover type of meter that has held sway, virtually in its present form, for the past 50 or 60 years, but thus far without noteworthy success. Another such attempt has recently been made by an eastern firm, their proposed meter having a cast-iron case and rotary valve, the upper half of the valve being made of ground glass. This meter is being tried experimentally. It is neat and compact in appearance and promises at least the possibility of greater durability and of greater capacity per unit of cost than the ordinary tin meter. In England Mr. Thorpe has recently introduced a decided novelty in the shape of a rotary meter, which operates on the principle of the anemometer and which is reported upon very favorably thus far by those who have tried it.

A straight reading meter dial, having, in addition to the usual dials and index figures, an arrangement whereby the figures constituting the correct reading of the meter appear at all times completely and plainly in view through openings in the dial plate, has recently been perfected, and meters equipped with them are about to be put upon the market at a slight advance in cost over those previously devised, in which the figures gradually revolve into view, as in such dials the figures are at times only partially visible, resulting in misreading of the meter.

Iron meter connections are now being recognized as possessing numerous advantages over lead connections, which they are rapidly beginning to displace.

The Glass complaint meter, perfected within the past five years, is now coming into general use and furnishes gas companies with a most ingenious and useful means for convincing doubtful consumers that they are really burning the quantity of gas charged for on their bills.

Progress is gradually being made in the use by gas companies of the standard meter threads adopted by the American Gas Light Association several years ago.

There seems to have been no special improvement in lock stopcocks for gas meters, but a novelty in the shape of a meter lock has very recently been put upon the market by an Ohio concern that is claimed to prevent consumers from disconnecting or bypassing their meters.

Some small improvements have been made in prepayment meters, but no distinctly new types have been introduced. These meters, as now made, are less apt to get out of order than formerly and some of the working parts have been made stronger. The cash boxes have also been improved. But the most noteworthy improvement in connection with prepayment meters is a safety device, recently brought out, which is said to allow the light to dim down, when the gas paid for has all been consumed, so as to be insufficient for use, but which does not allow it to go out altogether until about 15 hours have elapsed, thereby preventing accidents from being caused by persons putting coins into the meter after the light has gone out and so turning gas on in bed-rooms where lights have previously been burning.

Tapping Machines.—Tapping machines have been very much improved, and in addition to other new features are now so made that no gas escapes while the tapping is being done, thus saving gas and avoiding the risk of asphyxiation.

Recording Pressure Gages.—The improvements in recording pressure gages consist in the perfecting of the parts and increasing the variety and range of the gages so that they are now made to record anything between full vacuum and 10,000 pounds pressure per square inch.

High-pressure Gas Distribution.—One of the most important steps in the recent progress of the gas business is the distribution of artificial gas at high pressure, begun about three years ago and now demonstrated to be a mechanical and economical success. About twenty high-pressure systems are now in operation throughout the country, all of them reported as giving satisfaction and saving the owners money, especially in the matter of interest charges. There is one high-pressure line in the east that is 12 inches in diameter and 35 miles long. In Derby, Pa., there is a high-pressure system in operation of 35 or 40 miles of pipe, including services, in which the gas is brought at high pressure

direct to the consumers' meters, individual pressure regulators being used. F. H. Shelton, of Philadelphia, has been the leader in adopting this method of distribution, and after three years of experience he predicts that it will work a revolution in the gas practice of the next generation. George F. Goodnow read a paper at the meeting of the Wisconsin Gas Association last month describing the successful use of this system in his city, stating that in addition to the saving that it effects in the first cost of the plant, is gives the consumer better service and more regular pressure, with fewer freeze-offs in cold weather, besides affording a ready opportunity to employ intensified gas lighting for both street and interior illumination.

Low-pressure Gas Distribution.—Much attention is being paid to the proper and economical distribution of low-pressure gas. In some of the larger cities a system of so-called "pumping mains" is now running from the works direct to the various points in the distribution system where the gas pressure is at times insufficient. The gas is pumped into this system of mains at a sufficiently high pressure to adequately reinforce and equalize the pressure throughout the city, this reinforcement being automatically controlled by means of balance governors on the pumping mains, placed in pits in the streets at the points where such mains discharge into the regular distribution system. When the pressure in the distribution mains in any locality rises above the proper height at which the governor at this point is set, the discharge of the high-pressure gas into the distribution system at that point is automatically discontinued, but continues at the other locations in the city if still needed there. In fact, the pressure throughout the entire city is automatically regulated and equalized with an exactness and nicety absolutely impossible by means of pressure regulators at the works alone.

Gas engineers are also making progress in learning how to plan their distribution systems so as to secure the maximum conductivity per $1 expended for gas mains. Very large feeders and very small distributing mains are now coming to be recognized as the most economical arrangement. To quote from a paper read by Harry Edward Jones in 1901 before the English Institute of Civil Engineers: "The main arteries should be as few in number and of as large a diameter as possible in order to get the largest duty from the weight of metal employed and with the least friction." This same doctrine was forcibly enunciated by Henry L.

Doherty a year previously at a meeting of the Ohio Gas Light Association. A large distribution system is now being planned for a western city contemplating 12 and 16-inch feeders and 2-inch wrought-iron distributing mains, this arrangement having been determined upon as the most economical.

Thawing Services by Electricity.—This is an application of electricity that has been made within the past five years, having been first introduced at Madison in 1899, and later in other northern cities. A frozen gas service covered with several feet of frozen ground is a serious matter, but it has been demonstrated that by passing a current of electricity through the pipe it can be quickly heated to a temperature sufficient to melt the frozen water or moisture within it, and at a cost, with proper equipment, not to exceed $5 or $10, and as low, according to one company's occasional experience, as 80 cents.

Trenching Machines.—Improvements have recently been made in power machines for excavating trenches for gas mains, and one concern will this spring circularize the gas companies of the country with advertising matter with reference to their machine for this purpose. The machine operates somewhat like a vertical rotary snow plow, can be had of various sizes, and for gas companies in the larger cities, or for contractors who desire to bid on such work for the various gas companies in one neighborhood, it should reduce the cost of the trench work except where the soil is rocky.

Prevention of Electrolysis.—Unfortunately but little progress has been made in the prevention of the electrolytic destruction of gas pipes by the return current of electric street railways operating in their vicinity. Various makeshifts and palliatives have been resorted to, such as insulating joints, paints, glazed tile coverings, tar concrete, etc., but no substantial cure for the trouble has been extensively adopted, not so much because it is a physical impossibility to do this as because the courts have not yet clearly fixed the responsibility for remedying the trouble as between the gas companies and street railway companies. The trend of court decision is, however, to place the obligation for the prevention of the trouble upon the latter. An authority on this subject writes as follows under date of January 21, 1903:

"I regret that so little real advance has been made during the past five years in the prevention of electrolysis of gas pipes. The responsibility of electric railway companies for damage done by

their returning currents to the metallic pipes of gas companies and water companies has been a matter of vigorous litigation in State and Federal Courts for a number of years past, but in no case has a decision been arrived at which is final. In certain cases the courts have held the railway company responsible for damage, but have likewise held that the owners of the pipes must co-operate with the railway companies to prevent the damage. This has left the matter as much in the air as ever.

"It is commonly recognized that complete immunity of the pipes from injury cannot be successfully secured while the return currents of the railways are permitted to flow through the rails and earth. It is likewise recognized that the damage and danger may be greatly reduced by intelligent installation of the grounded return circuit of the railways and continuous careful supervision thereof. Railway companies have frequently been very seriously negligent in the way in which their return circuit has been installed, and they have been equally negligent in the way in which they have permitted their return circuits to become deteriorated.

"I think that the responsibility of the railway companies will be clearly determined by judicial decisions within the next two or three years, and we may then expect improvements to be entered upon which have been entirely neglected in the past. I look forward to the considerable extension of the conduit double trolley in our large cities, whereby the current is entirely removed from the earth, which will completely remove the possibility of danger from electrolysis in these cities, and I also look forward to the use, to some degree at least, of the double overhead trolley in some of our smaller cities. In other cities I imagine that the railway companies and the owners of pipes will come to some suitable compromise in which the railway company will acknowledge its liabilities and will join the owners to pay the expenses of continuous supervision and repair of the pipes."

MANUFACTURE.

Inclined Retorts.—Whatever may be said of the relative merits of inclines and horizontals, the use of the former has increased considerably during the past five years, and the construction of the system has been improved in some minor particulars. The retorts are made no longer than formerly, which is said to be an advantage, the Germans now making them as long as 18 feet and the English as long as 20 feet. The heats carried in inclined

benches have been greatly increased and their construction is therefore made stronger, with larger combustion chambers. The charging apparatus has been improved, measured charges by means of the "shot-pouch" system apparently being most in favor. A small hydraulic ram has been devised for moving the slide valves on the coal-measuring chambers, and one has also been devised for discharging the coke from the retorts when necessary. In one American installation the side walls are arranged to carry the weight of the upper and middle retorts, relieving the bottom retorts of this burden and presumably lessening the troubles due to expansion. During approximately the past five years, more than 10,000 inclined retorts have been installed in England. In this country, inclined retorts are in operation at Louisville, Ky., and installations are being erected in New York City and Lynn, Mass. At least three foreign inclined retort building companies are now represented in this country by well-known American gas-works construction firms, and two of our home companies are now prepared to build inclines after their own designs, while still another is making the same preparation. Just now, however, as is well known, gas engineers are disputing among themselves as to the relative economies of inclined retorts and horizontals operated by machinery.

Horizontal Retorts, Four Tiers High.—Benches of eight horizontal retorts placed four tiers high have been used in England for several years, but have only within the past year been adopted in this country, where they have suddenly become very popular, many persons claiming the credit of their "discovery." This style of setting is now being installed in Milwaukee, Detroit and Lowell, while the gas companies in many other cities, including Cincinnati, have decided to adopt them or are thinking of doing so. Obviously benches of this construction must needs be operated by machinery. Their advantages are:

(1) The same as those of the ordinary bench of 6's over the wide arch of a bench of 9's.

(2) A high and roomy combustion chamber.

(3) The most easily heated of any form of bench, and

(4) Economy of ground space.

Bench Furnishings and Settings.—There has been little improvement in the construction of bench furnaces. The rear clinkering bench, the use of which began in Germany and Great Britain

many years ago, and which was introduced in this country about 15 years ago, is gradually becoming popular. In recuperator benches the arches over the furnaces have been simplified, with block made larger and burned hard, with fewer clay joints and larger ports for the exit of the gases into the combustion chambers. By careful selection and mixture of clays, American retorts and settings are now claimed to be as good as any in the world.

Charging and Drawing Machinery.—Considerable progress has been made in the introduction in this country of charging and drawing machinery and in improving and perfecting the machines themselves. Machines are now going in at Milwaukee, Detroit and other cities, and many of the smaller companies also are considering their adoption. In fact, the tendency just now seems to be toward horizontal retorts, especially in benches of 8's, and machine charging and drawing, rather than inclined retorts. The machines have recently been improved by lightening their reciprocating parts, improving the material entered into their construction, replacing chains with wire ropes, etc. One machine has been improved by the addition of an attachment to the charging scoop which spreads out the coal as the scoop is withdrawn from the retort, contributing to better results when heavily charged. Another standard make of machine has been improved by increasing its capacity and introducing an automatic damping device on the operating cylinder of the drawing machine which makes it practically impossible to damage the seat of the retort, and at the same time increasing the life of all the reciprocating parts and doing away with the jar at the end of the stroke. There has also recently been put out a combined charging and drawing machine which has a promising future on account of its adaptability to the smaller sizes of retort houses, where, in the past, machine charging and drawing has not been practicable on account of the first cost of machines and the necessity for using two or more men on the separate machines. With the combined machine, one man is expected to take care of 20 benches in a single line or 15 to 18 benches where it is necessary to run the machine over a turn-table and return on the opposite side of the house. The combined machine will cost about two-thirds as much as the same capacity in separate machines. Compressed air, steam and hydraulic pressure are all used for operating the different makes of machines, each having its advocates.

Coal and Coke Conveyors.—With the enlargement of gas-works and the increasing danger from labor troubles, machinery for handling coal and coke is coming more and more into demand for the larger works and is being considerably improved. For handling coal in horizontal runs, the belt type of conveyor is in good favor, but for elevating coal and coke, as well as for moving them horizontally, gravity and self-filling grab and shovel buckets are being largely used. For conveying hot coke horizontally, belt or chain conveyors are in use and are undergoing considerable improvement. Most of the chain conveyors for hot coke use a flat-bottomed trough of either cast-iron or plate, through which the coke is pulled by means of cross-bars attached to one or two chains. The one-chain conveyor seems to be an improvement over the two-chain for the reason that the two chains do not stretch equally from wear, one soon becoming longer than the other, resulting in trouble with the sprocket wheels, etc. In one recently improved conveyor of this sort, for conducting hot coke away from the retorts and quenching it, the coke is partially submerged in about 4 inches of water in the trough and is pulled along so rapidly (about 100 feet per minute) that, according to the inventor, it does not have time to generate steam until it reaches the place provided for quenching it. The absence of steam is, however, probably due to the quick absorption of all the heat in the coke by the comparatively large volume of cold water into which it falls. Electricity is now being quite generally adopted as a motive power for driving coal and coke-conveying machinery.

Self-sealing Mouth-pieces.—These are being gradually improved, one concern having recently added a detachable clamp and locking device and providing a bushing in the lower part of the operating eccentric that will give equal wear in both top and bottom holes of the cotter-bar.

Hydraulic Mains.—There have been no noteworthy improvements in these, but the V-shaped mains are coming more into favor, and one concern has recently designed a V-shaped main the bottom of each section of which slopes gradually from both ends toward the middle, facilitating the withdrawal of the heavy tar.

Exhausters.—There has been quite a number of minor improvements in exhausters, tending to make the impellers more perfect in their lines and work and delivering a higher percentage of their theoretical displacement. These machines are now being

made in a greater variety of sizes and designs than formerly, exhausters delivering as high as 500,000 feet per hour, and 400 feet per revolution, being now in use. Exhausters are now made that are vertical, with side inlet and discharge, and also horizontal, with top and bottom inlet and discharge. Means have also been improved for keeping the exhausters in proper adjustment. An automatic regulating device for exhausters has recently been put into use that is said to be quite an improvement over the familiar Huntoon bucket. It is something like a natural gas regulator, with a sheep-skin diaphragm that admits of a long range of movement of the valve without any variation of the resistance on the diaphragm. It is said to hold the pressure constant over a wide range of variation of steam pressure and exhauster speed.

Tar Extractors.—Modern condensing systems provide for the removal of all tar before the gas reaches the washer scrubbers, thus making the latter more efficient. The familiar P. & A. tar extractor, as used in this country, has recently been improved to conform to its construction in Germany. A tar and carbonic acid extractor has been introduced, as well as a new tar extractor in which the gas passes through a rain or drip filled with liquid spray. One works has recently installed a centrifugal tar extractor that gives the gas a whirling or spiral motion, throwing the tar globules out against the sides of the pipe, where they impinge and flow down the sides of the pipe. Another experimenter thinks he has found a centrifugal tar extractor and exhauster combined, one apparatus serving both purposes.

Scrubbers and Washers.—The efficiency of tower scrubbers has been greatly increased by the use of an automatic flushing device such as was described at the meeting of the Ohio Gas Light Association in 1901. A revolving brush washer-scrubber, originally brought out in England, is also finding favor in this country. Systems of condensing, scrubbing and washing have recently been so much improved that the oxide purifiers have much less work to do than formerly and coals containing so much sulphur that they could not heretofore be economically used for gas manufacture can now be profitably utilized for this purpose.

Purification.—Considerable progress has been made in purification processes and apparatus during the past five years. Probably the most important process improvement is the one in which, as the inventor expresses it, "the purified gas revives the foul oxide."

As a matter of fact, of course, it is the slight percentage of air in the gas that does the work, and frequent emptying and refilling of the box is avoided by periodically, or as often as necessary, reversing the flow of the gas, by which means the oxide in each half of the box is alternately fouled and revived, one-half fouling while the other half is reviving, and *vice versa*. No special design of box is essential for this process, but the round or "cheese-box" form is being generally used. The so-called "duplex box" is also coming into use, in which there are two beds of oxide, one above the other, the gas entering between them and dividing into two streams, one stream passing upwards and the other downwards. This secures a slower rate of flow for a given area of box. In fact the present tendency of purifying box construction is toward compactness. These "double-deck" or duplex boxes are now being built as deep as 11 feet 6 inches, permitting two oxide beds each 5 feet in depth. Within the period under consideration the novel form of purifying box described at the meeting of the Ohio Gas Light Association in 1898 has been successfully introduced in several cities, and one of the most radical departures of recent times from customary purification practice has been made in connection with these boxes by dispensing with the purifying house itself. This has been done at Madison, Wis., where boxes of this construction have been successfully used out of doors throughout the past winter, the purifying house being purposely omitted. The boxes are double, constituting virtually one box 20 feet square and 13 feet 6 inches deep, supported on columns 6 feet 6 inches high, the space underneath being used for dumping the oxide. The boxes are lagged with pine sheeting, the total cost of which was only $250, and the space underneath them is enclosed by wooden doors hung on weights so that they can be raised and lowered like ordinary windows. Steam coils have been placed in this space for use, if necessary, in keeping the boxes warm, but on only one or two occasions during the past cold winter was the steam turned on as a precautionary measure, the temperature of the gas at the outlet of the boxes running generally 20 degrees higher than at their inlet, without the use of steam. The successful operation of these boxes under the circumstances described seems to indicate that purifying houses are wholly unnecessary. About four years ago, at Columbus, Ind., and more recently at New Orleans, there has been introduced a box of the ordinary shape but of a very cheap construction, with cement bottom and

sides and employing dry lute covers. Dry lute covers are being used to a considerable extent in England, and experience with them indicates that they can be employed with advantage and economy.

There have been some recent improvements in purifier trays, a new type having recently been patented by a member of the Ohio Gas Light Association. There is said to be a decided tendency at present toward the use of heavier trays; as in the English practice, trays 2 inches deep being used, with the slats thinner and closer together than in the ordinary trays.

Station Meters.—A noteworthy improvement has been made during the past five years in station meters, by the invention of a 3-compartment drum which is said to increase the capacity of the ordinary station meter from 30 to 50 per cent. I have thus far been unable to obtain a detailed description of the device, but there is no question that it constitutes a desirable and important improvement. There seems to have been no progress made in the perfecting and developing of proportional meters, although at least one prominent gas engineer is now at work upon a new type which he thinks will prove a solution of the problem.

Gas Holders.—Probably the important development in gas holder construction during the past five years is the metal-to-metal riveting of the holder shells and crowns without any paint or mixture of any kind between the sheets. One concern has also made a new design of goose-necks that obviates the use of adjustments for the rollers, thus avoiding the danger of the rollers being put out of proper adjustment by incompetent workmen or otherwise. Proposed cement holder tanks do not seem to be making much headway.

Valves.—An improved globe valve has recently come upon the market with renewable parts throughout, including the valve seat, and which can be packed under pressure while wide open.

An Ohio company has recently been incorporated to manufacture a safety valve for house service pipes, its purpose being to automatically cut off the flow of gas entirely if for any reason the pressure in the mains should be considerably decreased, or if the flow of gas should be temporarily interrupted.

There has been a great improvement in the ordinary large gate valves and a decided improvement in water-cooled valves for hot-blast work, one concern manufacturing several varieties of

the latter, in some of which the body of the valve only is kept cooled, and in others both body and valve seat, by streams of water passing through cases surrounding them. Another form permits the renewal of the seat of the valve when the old seat wears out.

Various ingenious multiple purifier valves have also recently been devised for directing and reversing the flow of gas in various ways through purifying boxes. And in this connection it should be stated that the days of the old-fashioned center-seal seem to be numbered, its place to be taken by these improved valves, which produce a more flexible means of handling the gas in accordance with the present advanced knowledge and practice in gas purification.

Stop-cocks.—Stop-cocks have been improved by making them of better metal, grinding them more perfectly, leaving larger gasways and making them of a greater variety of weights for various purposes.

Photometry.—There has been much progress made in the development of the principles and practice of photometry during the past five years, but before this art shall be perfected it is not unlikely that gas men will have no further use for it, as they may by that time be determining the value of their product by means of the calorimeter rather than the photometer. The recent progress and present needs of photometry are well set forth in the following extract from a letter received last month from Prof. C. P. Matthews, of Perdue University:

"We are still very far from the realization of a satisfactory primary standard of light, although distinct progress has been made in this direction during the past few years. The advent of several new light sources of the whiter hues has accentuated the difficulties heretofore experienced in photometry from color difference. Existing standards are not of the same hue as these new illuminants. There is evident need of a new standard having a quality or color that is a mean among the qualities possessed by sources of light in common use. As we are not likely for æsthetic reasons to tolerate sources that lie without the present range of color, it would seem that the time is ripe for the development of such standard, if that be possible.

"The candle and the carcel lamps are rapidly passing from use as light standards. In their place have risen the pentane standards, approved by the gas experts, and the Hefner amyl-acetate lamp, provisionally indorsed by the electrical fraternity.

"The need of uniform secondary standards bearing the stamp of official approval is likely to be met by the National Bureau of Standards at Washington, which will soon be in a position to supply standardized incandescent lamps for photometric purposes. Such lamps are well adapted to the photometry of the incandescent lamp or the naked gas flame. They are unsatisfactory for studies of mantle burners or the electric arc, owing to the color differences alluded to above. The existence of a common source of secondary standards will do much to unify photometric measurements and to lift them from the region of doubt and uncertainty in which they have so long resided."

Low Candle-power Gas.—As the result of the large use of incandescent burners and the increasing use of gas for fuel purposes, a high candle-power gas is no longer essential, and the demand for a low-priced gas that may be used yet more extensively for fuel has in the last few years brought about a decided change in our ideas as to candle-power, the tendency now being to decrease the candle-power and the cost while maintaining, so far as possible, the calorific value. In some large cities in Germany as low as 10-candle gas is distributed. Quoting from a leading English gas journal of December 28, 1901: "There appears now to be an overwhelming weight of technical opinion in favor of low candle-power gas, or at least in favor of a supply by each individual gas undertaking of that candle-power which its position as regards coal supply renders the cheapest, irrespective of candle-powers, within limits—limits which some would put at 14 candles, some at 12 and some as low as 10." The South Metropolitan Gas Company some time ago obtained Parliamentary sanction for reducing the candle-power of their gas from 16 to 14 and Parliament is now being petitioned by several other companies to allow them to distribute 13-candle gas. While these candle-powers would be too low for this country at present, as the public mind has not been educated to accept them, yet the tendency undoubtedly is downward, and this may account, in part, for the present noticeable return to coal-gas works construction that is reported by the gas-works builders of this country.

Ammonia Concentrators.—Ammonia concentrators have been improved chiefly as to their durability, some types being now made, in all their parts, wholly of cast-iron and lead.

Cyanide Extraction.—There has been considerable recent advancement in the extraction of cyanide compounds from illuminating gas, although progress in this direction seems to have been

wholly confined to European countries. Those companies which have engaged in the business are said to have found it profitable. One company is said to be netting $40,000 per year out of a make of a 1,000,000,000 feet of gas, by the manufacture of yellow prussiate of potash. Cyanide compounds are now being successfully and profitably obtained from the spent oxide, from the ammoniacal liquor and directly from the gas itself. One American gas chemist explains that the reason cyanide extraction is not being taken up by gas companies in this country at present is that a process is now being tried for making cyanide out of ammonia by the aid of metallic sodium manufactured electrotlytically at Niagara Falls, and as this process seems thus far to promise success, American gas companies are hesitating to invest any money in the business.

Water-gas Apparatus and Processes.—There seems to have been no radical improvements made in water-gas apparatus during the past five years. One concern has, however, brought out what they term a high carbureter design, in which the carbureter and superheater have been so extended as to crack up the oil at the lowest temperature possible, thereby retaining the heavy hydrocarbons. It also has a "wart" or "riser" connection between the generator and carbureter which is said to practically prevent the carrying over of ashes and cinders to the carbureting brick. They have also introduced what they term a divided blast construction, which consists of hollow bearing-bars connected with a blast box located in the lining. The bearing-bars have small openings opposite the spaces in the grate bars, through which the air is uniformly distributed under the entire grate. An eastern concern has recently introduced what they call on "economizer," its purpose being to utilize the heat that is generally blown up the chimney when blasting up the ordinary water-gas apparatus. They turn this hot blast through a shell containing a series of cast-iron tubes through which the feedwater to the boiler passes, thereby utilizing to excellent advantage (so it is claimed) this otherwise wasted heat. There are now two new oil sprays on the market for spraying oil into the carbureter, both of which are said to be very effective and advantageous. One original and enthusiastic experimenter reports that he is now constructing a plant on a fairly large scale by which he hopes to make water-gas by a continuous process. In California there is now in quite extensive use a new

process for making water-gas wholly out of California crude oil without any solid fuel whatever, but I have been unable to obtain a description of the apparatus and its operation.

The Dellwik process of water-gas manufacture, introduced within the past five years, has for some reason been tried only experimentally in this country, not having been regularly adopted, so far as I know, in any plant. But in England, and more especially in Germany, the process is gaining headway and promises much for economy in water-gas manufacture. Under this process, which increases the velocity of the air blast when blowing up the generator fuel to incandescence, the CO_2 does not have time to decompose to CO, and thus a much greater proportion of heat than with the ordinary process is imparted to the fuel bed, where it is needed, instead of being sent forward to the carbureter and superheater where so much heat is not needed, and thus a great waste of heat is prevented. The capacity of the apparatus is also thereby increased, which means a saving in cost of labor and in radiation of heat from the apparatus. A prominent American gas engineer writes me as follows:

"The Dellwik process, to my mind, is a fundamental discovery in gas making. But it seems hardly fair to regard it merely as a discovery in gas making, for it will have even a greater influence upon fuel economics and other industries than in the gas business. The discovery of this process is certainly more important, in my opinion, than any other discovery since the invention of the Low machine."

By-product Coke Ovens.—An idea of the progress of by-product coke ovens in this country may be gathered from the statement that in 1901 only about 5.4 per cent. of the total metallurgical coke manufactured was made in by-product coke ovens, whereas it is estimated by the best authority that with the ovens that have since been completed and that are now being built the additional production will be such as to bring the amount to 13 per cent. of the total. Five years ago gas companies looked upon by-product coke ovens as being simply an adjunct of the iron and steel business, but they are now beginning to adopt them for the manufacture of their own gas in those localities where there is a large use for coke. It is confidently predicted by one man engaged in the business that this process of making gas will, from now on, be rapidly adopted by many of the gas companies of this country.

There are now two or three different by-product coke oven processes in operation in the United States and many improvments have been made in them during the past five years. The size of the ovens themselves has been considerably increased and fire-brick and settings for their construction are now being made in this country equal to those obtainable from abroad, and much cheaper. In one process the benzol is extracted from that portion of the gas which is evolved during the last half of the carbonization and is used to enrich the gas evolving during the first half and that is intended for illuminating purposes. An under-fired principle has been adopted by means of which the gas used for heating the ovens is burned practically with a Bunsen flame. The foul gas mains have been elevated to avoid the formation of pitch and a new quenching car that is a great improvement over the old form has been put into use.

The growth of the by-product process in this country since 1897 has been as follows:

Year.	Number of Completed Ovens.
1897	280
1898	520
1899	1,020
1900	1,085
1901	1,165

producing 1,179,900 tons of coke.

At the close of 1901, there were also 1,533 ovens in course of erection, being considerably more than the total number then in use. There are now (March, 1903) 2,232 of these coke ovens in operation in this country, having a capacity for carbonizing about 13,400 tons of coal per day; and 1,286 additional ovens are being erected at the present time.

Gas Producers.—During the past five years the following improvements have been made in gas producers:

(1) The mechanical handling of coal and ashes has been improved and more nearly perfected.

(2) An automatic feeding and coal-distributing device has been put into successful use.

(3) An automatic water-cooled motor-driven stirrer has been devised and put into use, increasing the capacity of the producer about 20 per cent., conducing to a uniform quality of gas produced and decreasing labor.

(4) The Mond gas producing apparatus, saving the by-products, has been improved and largely introduced, especially in Europe. Detroit also has a plant of this character.

(5) An arrangement has been devised for operating the entire producer apparatus under a partial vacuum, the air and steam being sucked through the fuel bed by the engine itself, thus doing away with the boiler and holder, the steam being produced by an open heater close to the producer.

(6) Producers have been adapted to the manufacture of gas out of peat.

MISCELLANEOUS.

Odds and Ends from England.—English gas journals state that one experimenter, working up an idea advanced by Professor Lewes, seems to have discovered a practical process for successfully converting coal-tar into illuminating gas by means of a modified water-gas generator. Also that a well-known engineer has devised a reversible condenser for the extraction of naphthaline from the gas that has successfully withstood a year's working test. Professor Lewes also seems to have hit upon a successful method of enriching water-gas by passing it through coal-gas retorts during the process of carbonization. At Tipton, an admixture of about 30 per cent. of blue water-gas with coal-gas is being made in this manner, and the mixture is brought up to the candle-power of the original coal-gas by the use of only about one-third of a gallon of benzol per 1,000 feet of blue water-gas.

Acetylene Lighting.—There has been much progress in acetylene lighting during the past five years. In fact, practically all of the progress it has thus far made has necessarily been accomplished during the period named, as it was only seven years ago that a cheap method was discovered by manufacturing calcium carbide. The annual production of calcium carbide in this country is about 20,000 tons, in Europe about 50,000 tons. Notwithstanding this increased production, its price has not been materially reduced, being now in quantity about $65 per ton. In 1898 there were but two small plants in this country for manufacturing acetylene and distributing it as an illuminant by means of pipes in the streets; now there are 56 towns and villages lighted with it, the largest being Wabash, Indiana, with a population of 8,600. In Spain a city of 14,300 is being lighted with it, besides many smaller towns. In 1901 it was lighting 47 towns in Germany and

26 in France. Its use for portable and isolated lighting, such as carriages, railway coaches, country residences and club houses, has greatly increased and the means for its manufacture and consumption have been greatly improved. It has been discovered that a mixture of one part of acetylene to three parts Pintsch gas makes a much better illuminant for railway coaches than either of these gases alone, and this mixture is being largely adopted for car lighting in Germany and France. Probably the best and most authentic statement of the recent progress of acetylene lighting is the following made by Prof. Vivian B. Lewes in a lecture delivered in December, 1902:

"Although much hampered in its progress by the determined booming of improper forms of apparatus that gave rise to much trouble and waste, it has gone forward without a check, and improvements have been made in all directions. There are several generators now on the market which will leave little or nothing to be desired in their construction, as they are both simple and effective, and for country house lighting the beauty of the light has led to its firmly establishing itself as a favorite. In the early days bad generators and smoking of the burners proved difficulties, but the improvements in burners as well as in generators have been of a marked character, and besides the excellent burners of continental origin Bray is now making some excellent ones which show an improvement on the older forms of burner in that they can be turned down without smoking. This will do away with the inconvenience which was inseparable from the older forms of burners, of either having to turn out the jet or leave it burning at its full size."

Acetylene for general distribution and use does not, however, seem to obtain a foothold where ordinary coal or water-gas is obtainable.

Municipal Ownership of Gas-Works.—There seems to be no tendency toward municipal ownership of gas-works in this country, there having been but one such transfer in the last few years, that being the recent case of Holyoke, Mass. Taking into consideration the leasing of a private company of the Philadelphia Gas-Works, there is much less now being made by municipalities in this country than there was a few years ago. In Great Britain and Ireland the transfer from private to public ownership is proceeding so slowly as to be hardly noticeable, and the percentage of municipally owned gas-works is much smaller than the advocates of

municipal ownership would have us believe, being only about 17 per cent. of the total.

Conclusion.—The foregoing summary indicates that recent progress in the gas business has been chiefly along the following lines:

Gas engines,
"Arc" gas lamps,
Uses of gas for fuel,
Producer gas,
Low candle-power gas,
High-pressure distribution,
By-product coke ovens,

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Westinghouse, Church, Kerr & Co.,
Standard Lighting Co.,
R. D. Wood & Co.,
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Pleuger & Henger Mfg. Co.,
Sunlight Lava Mfg. Co.,
A. M. Gow,
E. F. Lloyd,
John Cabot,
B. E. Chollar,
John T. Wilkin,
Geo. Osius,
Dr. F. Schniewind,
O. N. Guldlin,
T. Littlehales,
C. G. Atwater,
L. P. Lowe,
E. C. Jones,
Wm. E. McKay,
C. Dellwik,
John Dell,
Wm. A. Miller,
W. E. Steinwedell,
C. E. Sanderson,
E. C. Brown,
Jas. H. Walker,
C. M. Keller,
C. W. Hinman,
Henry L. Doherty.

DISCUSSION.

President Andrews:—We have just heard a contribution in gas literature which I think will always remain a standard for all of us to examine on any point of general information. The subject has been covered so thoroughly that I do not see much chance for discussion. However, if any one has any questions to ask Mr. Butterworth as he is fresh in the details surrounding these figures, they will now be given an opportunity to ask them.

Mr. Stone:—Mr. President, in regard to the first sentence on page 16, with reference to low-pressure distribution Mr. Butterworth says: "A large distribution system is now being planned for a western city contemplating 12 and 16-inch feeders and 2-inch wrought-iron distributing mains; this arrangement having been

determined upon as the most economical." I wondered if that "2-inch wrought-iron distributing main" was not too light or whether it is a misprint. It seems to me that is rather small.

MR. BUTTERWORTH:—It is no misprint. They are arranging to put in 2-inch wrought-iron distributing mains. It is the city of Denver, Colorado. They are to be distributing mains, to be fed by the other mains. The pressure will be about normal or whatever is considered to be practicable. It is not a high-pressure system. The longest run of 2-inch pipe is an average of a half mile. At each end of this half mile of 2-inch main there will be a feeder line making the feeder lines a half mile apart.

MR. MCILHENNY:—I would like to ask for a little more information in reference to street mains. Mr. Butterworth states that a safety or balanced governor is now being placed ahead of the usual automatic governor, for the purpose of delivering gas to the latter at a constant pressure. I would like to ask about how many such arrangements have been installed that Mr. Butterworth knows of?

MR. BUTTERWORTH:—I cannot state the number, but I think Mr. Hayward probably can furnish some information on that subject.

MR. HAYWARD:—I will be glad to answer that question. The question has come up several times and I have been interested in it from the fact that the large number of holders that have been constructed during the last two or three years have been three-lift holders. With three-lift holders of course you know there is a difference of pressure and it often runs up as high as 10, 12 and 14 inches with the three-lifts. That is because of the different pressure which depends upon which lift is cupped. The result is that the inlet pressure on the automatic governor varies, depending upon which lift is cupped and to do away with that the balanced governor is set to the pressure of the lowest lift or the lowest pressure, so that the other two beyond the cup will always give a uniform pressure. There is another advantage and that is the matter of safety. I believe in Europe they call it the safety governor. In case of any accident to the automatic or the regulating governor, the pressure will never be greater than indicated by the safety governor. As to the question asked by Mr. McIlhenny, with reference to how many have been installed, I will say that every three-lift holder that I know of that has gone up in this country during the last two or three years has always

had a balanced governor ahead, and I do not know of a single case where there is an exception to that rule. So the answer is that out of probably fifty governors sold this year, at least 75 per cent. of the governors sold have been sold in double governors, a balanced governor always ahead of the automatic. I trust I have made this perfectly clear to you.

MR. PERKINS:—I would like to move a hearty vote of thanks to the editor, Mr. Irvin Butterworth, with the recommendation that he be continued in office. He seems to have covered the ground very thoroughly indeed, and I think this is one of the most valuable contributions to gas literature we have had for years.

MR. McILHENNY:—I take great pleasure in seconding the motion as well as the recommendation.

MR. BUTTERWORTH:—Mr. President, if remarks are in order I wish to say that I am not anxious for the job another year at all. I think you are fining a man for trying to do his best.

The above motion was then unanimously adopted.

PRESIDENT ANDREWS:—We are now up to the question box under the editorship of Mr. Doherty.

MR. DOHERTY:—As near as I can make out from the lists handed in the question which received the most votes is: "Are 8-hour shifts desirable?"

The Association then listened to the reading of the

QUESTION BOX.

BY HENRY L. DOHERTY.

Introduction.

The value of any association of this character must be measured by the services it can render its members. While attempting to advance our business methods, it is surely not inconsistent to endeavor to advance our Association methods. It is reasonable to suppose that the members of this Association will keenly appreciate that information which they most desire. Can any committee or officers of an association predetermine what will be most prized by all of their members? I think not. Some expression must be obtained individually from the members. This can best be done by means of the question box. The idea is not a new one, but I think the officers of this Association have put

the question box on a higher plane and have elaborated its scope far beyond the comprehension of the original proposers ideas. This plan, if carried to its logical conclusion, will make the annual conventions of this Association an exchange market for ideas and a clearing house of knowledge.

The benefits of co-operation increase faster than the arithmetical increase in the number of participants, and the greatest good will result from the greatest degree of co-operation. Within the limits of our own membership we may not find the best solutions to the problems which confront our members, but in our efforts to solve the problems we meet we must certainly benefit some of those outside of our membership limit, and this should be sufficient warrant to look beyond our membership for co-operaiton and assistance and I think we will not seek this help in vain. The fraternal ties between gas managers are due to more rational causes than Association membership.

The offering to this convention does not equal my expectations, although the number of questions asked for exceeded my calculations. It has been found impossible to supply the information requested for many reasons. The time was short, the plan not well understood, and much to my regret I have been unable to secure the co-operation of many able gas engineers fully able to supply the information wanted with but slight inconvenience to themselves.

Is the tendency towards a less strict observance of professional ethics?

I think not. I hope not.

The future of the gas business—the very existence of our Associations—depends upon the willingness of gas managers to give freely of their stock of knowledge. I hope the question box idea will be tried another year, and we will again ask the members of the gas fraternity for assistance, and when they see how earnest we are and how unselfishly we use the information thus secured I am sure we will not ask for their assistance in vain.

I cannot refrain from commenting upon the points brought out by this treatment of the question box. Numerous problems of primary importance are not generally understood, and my reason for saying they are not generally understood is because all gas managers and gas engineers do not agree in their views. Recognizing this condition, I very naturally found myself planning some method for its remedy, and after careful thought

have come to the conclusion that we should establish a department for research and investigation work, and this matter will be treated by separate recommendations to your Association.

A slip was sent out asking for general information as follows:

(1) Each company is requested to describe their method of mapping main, showing symbols used to designate sizes of mains, drips, specials, etc. The object of this is to evolve some standard method which can eventually be adopted by all companies.

(2) What disposition do you make of your coke breeze?

(3) Each company is asked to make a list of all purposes for which gas is used in their town, and if possible to give the amount of gas used for each purpose. The object of this inquiry is to open up generally new uses for gas where such use may now be confined to only one or a few towns.

(4) What sizes of coke do you prepare for the market and by what names do you designate these sizes? The object of this inquiry is to recommend some standard sizes and provide standard nomenclature for their designation. It is also believed that the coke market can be advantageously cultivated if standard sizes of coke are prepared, thus enabling stove manufacturers to properly design their stoves for the standard sizes.

(5) Let each company describe the method used for scurfing retorts, with data regarding frequency of scurfing and time required.

(6) What special form of furnace grates or stokers are used for burning breeze, and what is its fuel value in comparison with good steam coal?

(7) What paint do you paint your holders with, and why do you prefer it?

Very few responses were received. None of the companies in this Association seem to use the same system for mapping mains. I cannot see but what conditions are so nearly the same that all companies could advantageously use the same system. There must be some one best system, or some best system can be evolved from the present systems in use, but I found this matter to be beyond the scope of this department. I will make a separate recommendation that the Association take up this matter with the idea of evolving some uniform system of mapping mains which can be eventually adopted by all companies.

Few replies were received regarding the disposition of coke breeze. It is pretty generally used as a fuel, but I did not get

sufficient information on this matter to make any recommendations. Coke breeze is burned under the boilers for steam raising, but I could not ascertain what results were obtained from its use. Some companies use a steam jet blower and an ordinary grate. Other companies find it possible to burn their coke breeze with a natural draft and a fish-bone grate. The Milwaukee company are burning their breeze successfully with a patent hollow-grate bar. The Denver company burn their breeze under their boilers, using an American underfeed stoker. The Detroit company use their coke breeze in their water-gas machine and apparently to better advantage than would result from its use under the boilers. A scoop of proper design is inserted in the charging door of their water-gas machine and by revolving this scoop the breeze is deposited around the edge of the fuel bed. This drives the blast to the center and they apparently increase the capacity of their machine without any bad results whatever, and the breeze fed to their generators seems to have the same value as good coarse coke.

Question No. 3 of the general information brought out the following uses for gas:

Gas engines,
Ladle furnaces,
Confectioner's boilers,
Bakers' fryers,
Coffee roasters,
Brazing furnaces,
Crucible furnaces,
Annealing furnaces,
Enameling ovens,
Drug stills,
Beer vat dryers,
Hard oil melters,
Tailor's gas irons,
Meat broilers,
Multiple burners,
Gas water heaters,
Gas grates,
Laundry stoves,
Heating type metal,
Curling irons,
Cigar branding machines,
Linotype machines,
Banana ripeners,
Singeing machines,
Shampoo dryers,
Corset bust block heaters,
Heating incubators,
Hotel broilers,
Water urns,
Embossing leather,
Heating wax,
Bakers,
Heating rivets,
Vulcanizing rubber,
Welding,
Heating glue,
Smelting,
Melting brass and babbitt,
Water heating,
Blow pipes,
Case hardening furnace,
Cigar lighters,
Cake griddles,
Chafing dish,

Forge for rod heating,
Hot steaming press,
Hair dryer,
Oven furnace,
Photography burnishing,
Sealing wax heaters,
Ventilating burner,
Willow chair singer,
Keg branding,
Candy making,
Soldering iron furnaces,
Gas forges,
Assay furnaces,
Stereotyping metal melters,
Drying ovens,
China kiln,
Water stills,
Gas laundry mangles,
Plaiting and crimping rolls,
Rendering kettles,
Dental furnaces,
Gas ranges,
Backus heaters,
Clothes dryers,
Portable heaters,
Barbers' kettles,
Glue pots,
Shoe burnishing machines,
Soda fountains,
Can soldering machines,
Hat shapers,
Peanut roasters,
Cloth sprayers skirt mfg.,
Heating steam tables,
Coffee urns,
Heating irons for polishing leather,
Oyster cookers,
Enameling and jappanning,
Heating metal plates,
Re-sweating tobacco,
Heating branding irons,
Babbitt metal melters,
Laboratories,
Heating tools,
Tire setting,
Heating glass molds,
Tempering,
Band shrinking furnace,
Carbonizing furnace for carbonizing electric burners,
Capsule making,
Dry hot-air baths,
Gas machine for hulling beans,
Hot air lamps,
Muffle furnace,
Pure food mfg.,
Steam boilers,
Toasters,
Vehicle tire setting.

I think this is a branch which should in the future be covered by the Progress editor's report, and therefore I request all readers of this information to look over this list and add to it any uses for gas which are omitted, sending such omissions to the Progress editor.

This question box department will often develop subjects which are entirely too broad to be properly considered as a portion of the question·box, and where such subjects are uncovered I think it the duty of the editor of this department to recommend these subjects to the special consideration of the Association. Question No. 4 is of this character. No uniformity now prevails regarding the sizes of coke prepared for the market and no standard nomenclature has been evolved to designate these sizes even

were they uniform. I will treat this matter by an independent recommendation to the Association.

Questions 5 and 7 did not bring out any information which is worth commenting upon.

I want to acknowledge my thanks to the following people who have assisted my in this work: Frank W. Frueauff, Secretary; Irvin Butterworth, President, and W. A. Baehr, Superintendent Gas Department, all of the Denver Gas and Electric Company, Denver, Colo.; Alfred E. Forstall, of New York, and Walton Forstall, of Philadelphia, for references furnished; Harriet E. Billings, Assistant Secretary of the National Electric Light Association, whose zeal and industry made a former effort of this sort a success for the National Electric Light Association, and to whom I am indebted for some of the methods used in the work for the Ohio Gas Light Association.

I also want to commend to the appreciation of this Association and acknowledge my personal indebtedness to those unselfish gas managers and engineers who have generously contributed to this work and whose liberality has made this department possible.

If this contribution to gas literature finds value in the eyes of the gas fraternity, I hope their appreciation will be manifested by their future support. The expenses, work and worry are dedicated to the progress, co-operation and advancement of the gas business, the gas fraternity and gas engineering science.

QUESTIONS.

No. 413. Are eight-hour shifts desirable?

FREMONT GAS LIGHT AND COKE COMPANY.—No.

F. W. STONE.—At a small works you cannot always afford to keep a general foreman. In this case the men want to be the best you can get so that your machinery and works will be kept up and the works looked after so as to get the best results. Our experience has been that it is best to pay the men as a unit according to the whole amount of work done, and work eight-hour shifts, the men dividing up the work.

C. O. G. MILLER.—I think they are. A 12-hour shift is a very long one and the whole tendency of the country appears to be toward shorter hours. A man does more work per hour in an eight-hour shift if he attends to his business than he will in a 12-hour shift.

ORAL DISCUSSION.

PRESIDENT ANDREWS:—Gentlemen, the question is open for oral discussion. I will call upon Mr. McIlhenny to open the discussion.

MR. MCILHENNY:—I do not know a great deal about it, except that probably all of us have had some experience with this subject, and realized that it is a problem we will have to consider and dispose of. I know of one company that had to come to it. The men stated they could get along with a fewer number of men and, while we could since that time have restored the former condition, we have not undertaken to do so. We are not prepared to say whether it is economical or not. It probably is not quite so economical as the previous plan, but we cannot help ourselves.

MR. CLANSEN:—We have had some trouble along this line at Portsmouth, O. The men asked for an eigth-hour shift and we installed an eight-hour shift. I think the results were just as good, if not better than when we were working on a 12-hour shift. There is always some time that the men must rest up and our experience has been that we can get along about as well on an eight-hour shift as we can on a 12-hour shift for the same amount of money.

MR. MILLER:—In regard to this matter; there is no question in my mind but what you will be able to get along with an eight-hour shift, but whether it will be as economical or not is quite a different matter. I do not think it would be as economical. It is all a matter of wages. If the men working eight hours only receive two-thirds as much pay as they receive when working 12 hours, then of course it would make no difference, but I doubt very much whether we could lower the wages to that extent and for that reason we have considered it best to work on a 12-hour basis.

MR. DOHERTY:—Before passing to the next question I simply desire to state that the tendency in all labor circles seems to be towards shorter hours with the same pay or an increased pay upon a *per diem* basis, so that I would advise every gas company to do what I have done in the company with which I am connected and that is to pay strictly on an hourly basis, and then you can make it more apparent to the workmen when they ask for a diminution of hours from 12 to eight that they are making a

radical demand. Decreasing the hours from 12 to eight at the same pay is equivalent to increasing the pay 50 per cent. and if you are paying on an hourly basis you can probably be in a better position to compromise than you can if you are paying on a daily basis.

Question No. 3 is the second most popular question:

No. 3. Assuming that some coal must be stored to insure a supply at the works, is it better to leave the same coal stored all the time for any emergency that might arise, and use fresh coal as far as possible, or it is better to use the oldest coal, and should the old coal be cleaned out once a year?

J. H. Enright:—If coal must be stored to insure a supply at the works, I believe it far better not to retain it longer than one can possibly help, as I find it far more economical to use coal as near fresh as possible.

G. N. Clapp:—For 28 years I have tried leaving the same coal stored, and have used it up every year. The coal stored for several years yields much less than when used up each year. We also notice that in using coal which had been stored in the yards and was shipped to the gas company when coal was scarce, the yield is less and of course it weighs less and is more bulky to handle.

C. E. Burrows:—If we use the old coal first, the new is ageing, so that I cannot see that it makes any difference. It is a mere matter of convenience.

V. L. Elbert:—It depends entirely on the condition of storage. Coal loses 18 per cent. of its value per year by standing. Consequently the fresher the coal and the sooner carbonized, the better will be the results.

B. H. Petley:—I believe that it is better to use the oldest coal rather than fresh coal, because coal in storage suffers deterioration, and the danger arising from spontaneous combustion is avoided.

Thos. D. Miller:—I believe it is better to have the coal storage bins so arranged that the coal can be used by observing the rule of constantly working out the oldest coal so that if the stock of coal is sufficient to cover a six months supply, the coal stock would never, at any time, be over six months old. Occasions might arise when we would be warranted in using the freshest coal available, but for regular running I think the method indicated the best and the most economical in the long run.

FREEPORT GAS LIGHT AND COKE CO.:—From our experience we get just as good results from Youghiogheny one or two years old, but would advise using within three years.

EDITOR:—This question warrants extensive investigation. My belief is that coal deteriorates rapidly at first and then changes less and less. A time must come when the change becomes almost unnoticeable. If this belief is correct, why should we aim to use the stored coal periodically when no appreciable change would occur were it left stored for another year. We have reason to believe that in restocking fresh coal, the depreciation will be far greater than would be the depreciation on the old coal if left stored for another year. Why pocket this loss every year? I append chart which tends to bear out my position, although I do not think it worthy of great consideration.

HENRY B. LEACH:—Our experience, with Westmoreland coal, is that the shed should be cleaned out once a year if possible.

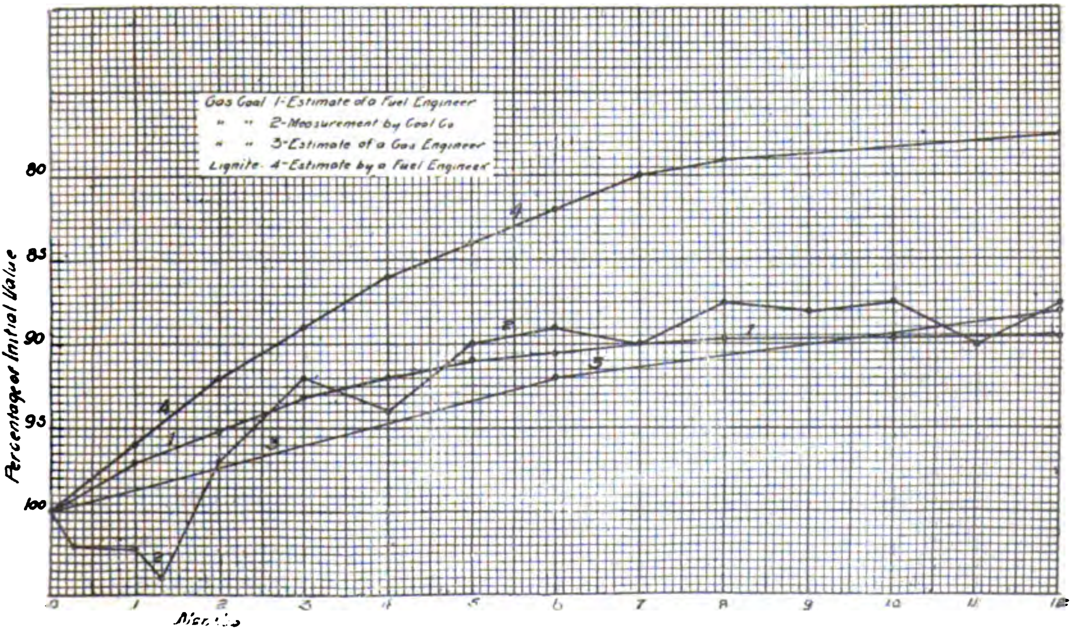
ORAL DISCUSSION.

MR. DOHERTY:—This chart shows three estimates. One purports to be the measurement of a coal company, but the conditions under which it was made are rather doubtful and it is so peculiar as to excite suspicion. According to this chart your coal for the first 40 days becomes better instead of worse and then it depreciates during the next 50 days—it depreciates very rapidly and from then on it depreciates more slowly. So of course one safe rule would probably be to store that coal which will depreciate the least. Now, according to this chart—which is supposed to be the measurement of the coal company—unless you used your coal in the first 40 or 50 days, then it is not so much consequence when you used it, but always try to use your coal before it has been stored 40 or 50 days. The question is now ready for oral discussion.

MR. OSBORN:—If you use 8 per cent. as a multiple, in 13 years it would run it into the ground, wouldn't it? I know of coal that has been in store for 13 years and while it is pretty good coal yet it is not as good as if used when it was fresh.

MR. MILLER:—About four years ago we had occasion to commence using a stock of coal that had been stored 20 years previous to that time. It was Youghiogheny coal and the results attained from it were equivalent to any coal received the previous years. It had been stored under cover for 20 years. At the

present time we are working in a similar way to that stated by Thomas D. Miller in his printed answer to the question. He says: "I believe it is better to have coal storage bins so arranged that the coal can be used by observing the rule of constantly working out the oldest coal, so that if the stock of coal is sufficient to cover a six months' supply, the coal stock would never at any time be over six months old." While this is very good, it is not economical to work in that manner, because we must use our coal as we receive it at the wharf landings. There are times that we receive no coal for four, five or six months during the summer. During that time, if we hadn't coal stored in barges, we would have to use coal from the stock in the yards, but if we have a freshet and can get coal from Pittsburg or the Kanawha mines, we commence using the freshly mined and from the freshly mined coal we get a little better result than from the coal which has been stored for a year. This question, I presume, refers to coal not under cover. Some of our coal is stored to the depth of 38 or 40 feet, and we find that the top, two or three feet, will depreci-



LOSSES IN COAL DUE TO TIME STORAGE.

ate probably to the extent of 5 to 6 per cent. the first two years, but the coal below that we can always get as good yield from as any coal obtained the previous year. This is out in the open.

MR. STONE:—I was in Buffalo some four or five years ago, and the manager of the gas company there was using up some coal that had been in the stock pile a number of years; I think possibly as many as 12 years, and his experience coincided with the gentleman who has just spoken. The top one or two feet of coal was depreciated, but inside of that it was all right. It was stored something like 20 feet high, but the inside of the pile was all right. He said he could not tell but that it was just as good as the coal he got fresh from the mines. But outside, where coal was exposed to the weather, it had depreciated about 5 or 10 per cent.

MR. DOHERTY:—The next question in popularity is

NO. 13. Are purifying houses necessary?

V. L. ELBERT:—Yes.

(*a*) To protect the men when filling boxes in winter.

(*b*) To protect the oxide from the elements, when revivifying.

(*c*) To protect the boxes in summer from extreme heat.

HENRY M. HUNT:—In a country of extremes in temperatures, yes. Depends on climate.

THOS. D. MILLER:—Purifying houses are necessary in extremely cold climates because of the reduction in temperature of the gas in the purifying box, and the consequent reduction in the chemical action going on in the purifying material, chemical action occurring more readily in the presence of heat.

FREEPORT GAS, LIGHT AND COKE COMPANY:—Yes, in northern latitude.

JOHN GIMPER:—To answer this question it will be necessary first to ask some questions and answer those.

First: Is purification a mechanical or chemical process?

Second: Does purification take place equally as satisfactorily under all temperatures?

In answer to the first question, that it is a chemical process, no one will dispute; and upon the second question really hinges the primary one. It is a well-known law in chemistry that any process is a chemical one which does in itself evolve heat to a

lower or higher degree. The revivification of oxide and its production of heat is a clear example of this law. I think it is the general practice when we want to revivify oxide, to first heap it up before spreading it out, because experience has taught us that revivification takes place more rapidly and efficiently when we assist the process by allowing this accumulation of heat. Is it not reasonable, therefore, to suppose that it is good practice to keep the oxide in the boxes at such a temperature as will assist the process of purification? There is no doubt that we can keep too high or too low a temperaure which will retard or entirely prevent the process of purification. It is therefore necessary to maintain that degree of temperature which is the most conducive to purification. Can this be done without the assistance of housing the purifying boxes in every locality? I believe not. Consequently, I answer, purifying houses are necessary. There are, however, localities where only shelter is needed to protect from rains and sun.

EDITOR:—Purifying houses are unnecessary and their non-use permits the investment to be greatly reduced, and the present relation between fixed and operating costs is such that it behooves every gas engineer to study means for reducing his purifying equipment investment, as this offers greater opportunity for saving than can any change in operating methods, assuming that cost of purification is no higher than pertains in well-regulated plants.

O. O. THWING:—Purifying houses may not be necessary, but they are extremely desirable, particularly in regions where the temperature falls to freezing or below, or where it is liable to rain or snow for a few days, when it is necessary to change them.

M. E. MALONE:—Purifying houses are not necessary if a modern type of box is used. We have installed at Madison, Wis., a Doherty-Butterworth purifying box which is situated out of doors. It is lagged with double sheeting of ⅞-inch tongued and grooved boards, between which is a layer of building paper. The top is sheeted in a similar manner, and also covered with galvanized iron. Openings provided with hood coverings are arranged in the top to permit of access to the filling doors, and four counter-weighted doors are provided on each side of the sheeting, near the ground, for ready access underneath the box. The entire cost of covering, including two coats of paint, was a little under $300, which is many times less than the cost of the most cheaply constructed purifying house.

A steam coil was provided under the box and, notwithstanding there was considerable cold weather during the past winter—one spell lasting four days, when the thermometer dropped to 15 degrees below zero—we did not find it necessary to use any steam, and during this period the temperature of the gas at the outlet of the box ranged from 50 and 60 degrees, in fact, owing to the chemical actions which take place in the box, the gas comes out of the box at a temperature at least equal to the temperature at the inlet, and usually, somewhat higher.

We also have two old style boxes situated in a purifying house, and have found it necessary to keep steam on the purifying house whenever the thermometer dropped below 40 degrees.

To sum up in a few words: It is possible with the D-B box, arranged as our Madison box is arranged, and situated out of doors to work without the use of any external heat whatever. This is impossible where ordinary boxes are put in an ordinary purifying house, as the radiation of the building is so much greater, owing to the fact that the area is so much greater. It is also necessary to thoroughly ventilate a purifying house, to guard against an explosive mixture of gas and air, and for this reason, heating is absolutely necessary.

The only possible objection that could be advanced against placing a purifying box out of doors is the difficulty that one might expect in maintaining the temperature, but the temperature can be maintained with this kind of a box more readily, even though situated out of doors than on an ordinary box in a purifying house, and no bad effects can follow. It is, of course, necessary to have some sort of a shed or building for reviving spent oxide, but this building can be of very cheap construction, and it is hardly necessary to make it even fireproof, as the damage would be slight should it burn, and the loss would be trifling.

ORAL DISCUSSION.

Mr. Thwing:—I think purifying houses could be dispensed with if you have capacity sufficient to allow you to get along some time without changing the boxes.

Mr. Schwarm:—May we ask for a little more explicit information as to the construction of that Doherty-Butterworth purifying box? It is not very clearly expressed, and I would like to have some clearer expression of it.

President Andrews:—That box was described in detail in the printed proceedings of the Ohio Association, and will be found in the proceedings of the annual meeting for the year 1898.

Mr. Hayward:—I feel that this is quite an important subject and ought to be discussed somewhat fully. I think Mr. Gimper strikes the nail on the head. If I remember rightly, Mr. Gimper is located in Galveston. In rather a warm country, and he ought to be able to talk entertainingly on this subject as to whether or not you need a purifying house. He says that this matter of purification is a chemiacl process, and if a chemical process, then more or less heat is generated. My own experience is largely theoretical, because I am not engaged in the practical business of purifying gas, but in the purifying material business. I found in this experience, that often where complaints are made that the oxide will not work properly, it is in the winter time when the temperature has run down so low in the purifying house that the chemical action is not taking place. When the temperature runs down below 40 degrees in the purifying house then there is that much less chemical action taking place. Even at Louisville, some years ago, this same matter came up. Now, Louisville is not a very cold locality, and yet in that purifying house down there they had all sorts of trouble, and not until they brought the temperature of the purifying house up to about the same temperature as the gas when it enters the box were they able to get proper results from it. Mr. Malone, in speaking of it, says he has given protection to his house by sheathing both on the sides, top and bottom, and he has, to a certain extent, protected it from low temperature. He has also taken the precaution of putting in steam pipes so that he is able to protect it somewhat. It is so constructed that he has not so much of an area to heat up as he would in the ordinary purifying house. But it seems to me that it is very essential, especially in the old type of box, where the oxide is not so deep, and where there is a smaller quantity used, this matter of temperature is a very essential element in purification. I wish this matter would be taken up more fully, and gone into more thoroughly. I think this is a subject where we ought not to jump at conclusions too suddenly in regard to this matter of temperature, because it is a very essential element in the process of purification.

Mr. Lea:—The English practice, where the climate is very mild in the winter, is to build a box, ordinarily 5 or 6 feet deep,

out in the open, on a foundation that is below the surface of the ground, so that when the ground is filled in you get an operating floor just a reasonable distance below the top of the seals, which would correspond to the wooden operating floor of the ordinary purifying house. Then they put a wooden shed over the top of that so that in changing the boxes they are protected from the weather. It very seldom snows in London, and the South Metropolitan Gas Company, which makes the cheapest gas, has all of its boxes built in that way. Other companies have adopted the same plan. By having them under ground, even if they had a little frost, the lower part of the box would still be compartively warm.

Mr. Steenbergen:—I would like to ask if any gentleman has had any experience in the use of concrete boxes? I have one in use, 8 x 8 x 4 feet deep, and which I have found to be perfectly satisfactory, and haven't had any inconvenience from the cold weather, although it is out of doors and unprotected, I have experienced no trouble with it, even though the thermometer was down to zero.

Mr. Miller:—Do you consider it unnecessary to have purifying houses whatever may be the temperature of the climate? In our experience we consider it good practice to provide the revivifying room with lattice windows, having them open in the summer and in the winter time putting in glazed sash to keep the room warm.

Mr. Doherty:—There is no advantage in building a purifying house if the purifying house won't maintain the temperature as well, or better, than by putting the boxes out of doors. I do not see why you should adopt that form of construction which is most expensive, and which gives you the least protection against the elements. We took the precautionary measure of putting steam pipes under these boxes and we found them entirely unnecessary because we reduced the radiating surface, or area, for the radiation of heat to such a small amount that the heat generated in the boxes is more than enough to compensate for the radiation. In Madison, Wis., the thermometer goes down 35 degrees below zero. We had a chance to measure the work of these boxes, alongside of boxes housed in the usual manner, and we found the boxes inside of the houses have to have steam heat whenever the temperature falls below 40 degrees, but we found the other boxes which were situated out of doors, and which were protected simply

by sheeting did not have to have steam even if the thermometer fell to 15 below zero. That is very easily understood, I think. You do not have to ventilate the cover of that box. Nothing can get into the cover of the box to cause an explosion; there is no room for a violent explosion except below the box. Take a great many of the purifying houses throughout the country, as Mr. Hayward pointed out, they do not secure good results because they are not able to maintain the temperature ordinarily required for purification. In one of our plants we have just such a condition. We have a big purifying house. It is necessary to ventilate that house thoroughly, and practically all the exhaust steam of the works will not keep up the temperature in the purifying house to the point it should be and the gas cools in proportion to the radiating surface of this box exposed to the atmosphere of that room. I cannot see any particular object in a purifying house except to protect the men from the elements in filling and emptying the boxes and to maintain the temperature of the boxes. The temperature proposition is settled. There is no other form of construction that will permit the purification process without the use of some external heat. That thing, I think, is settled. Now, the matter of filling and emptying the boxes: We figure that we will not have to fill or empty a box more than once a year. We can do that in the summer time, and even in the winter time, if it became necessary to do so, it would be a very short job to fill and empty it. We use a pneumatic conveyor, or an air blast, to fill the boxes, and the only place the men would have to work would be directly under the box, where they are protected from the weather when the boxes are changed.

Mr. Steenbergen:—What is the depth of the boxes?

Mr. Doherty:—It is a box where the oxide lays in vertical beds and not in horizontal beds. The total depth of the box, I think, is 13.5 feet, and it sets 6 feet 6 inches above the ground. What is called the Chollar box, which is cylindrical, is also applicable to outdoor use.

Mr. Hayward:—Then it is positively settled that as a question of temperature it is not safe to put a purifying box outdoors without any protection, isnt it?

Mr. Doherty:—Yes.

Mr. Hayward:—I wanted to have it sufficiently clear so that we will all understand it, that you could not put a box outside without giving it any protection.

MR. DOHERTY:—You have to maintain a certain temperature in the box for the purifying process, but in constructing the box, the way we constructed the one at Madison, Wis., we can more easily maintain that desired temperature than we can by the old form of construction.

MR. MILLER:—Won't you have to have a receptacle for the reception of the fouled materials?

MR. DOHERTY:—A house would be required to put it into when you revivify it, although that would not be necessary if you had capacity enough in your boxes, because you could always revivify in the summer time, but the cost of constructing a revivifying shed is insignificant as compared with the cost of constructing a purifying house.

MR. DOHERTY:—The next question from the standpoint of popularity seems to be question No. 40. There seems to be more interest in problems relating to the purification of gas than anything else. I have received more questions directed toward the purification of gas than any other one subject. To my mind I think it is the least important of all the subjects that a gas man has to contend with, that is if they are problems from the standpoint of gas economics.

No. 40. What is the present practice in building new coal-gas purifying houses, in regard to the number of boxes, *i. e.*, where it is desired to run without adding air, would it not be better to have 3 instead of 2 deep boxes, using one as a reserve to turn in when changing the third?

C. E. BURROWS:—We think three boxes are far preferable.

V. L. ELBERT:—Yes, three and better, with four, where no air is used.

THOS. D. MILLER:—The best known practice is to build two boxes. If the boxes are large enough one will do all the work, the other is simply in reserve.

FREEPORT GAS, LIGHT AND COKE COMMPANY:—Yes. Better have three.

ALFRED E. FORSTALL:—Reference, *American Gas Light Journal*, Vol. 77, page 586.

MR. DOHERTY:—The next question is

No. 43. How does the cost of purification in the west compare with the cost 10 years ago?

E. M. OSBORN:—It is much cheaper.

C. E. BURROWS:—Ten years ago we were using the same material we now use, *viz.*, home-made sponge, and the cost is so small as to be almost a negligable quantity.

THOS. D. MILLER:—The cost of purification of gas at Dallas, Tex., is about one-tenth of what it was 10 years ago.

FREEPORT GAS, LIGHT AND COKE COMPANY:—Owing to improved facilities less than half.

EDITOR:—The cost has certainly diminished considerably. The knowledge of the effect of velocity on purifying results has done more to cheapen the cost than has any other factor. Good scrubbing has also cheapened the cost. A good engineer should always consider both the fixed and operating costs of everything, aiming to get the lowest total cost. Money is often invested in purifying equipment (ground space, houses, boxes, valves, conveyors, etc.) for the sake of reducing operating expenses, which is entirely unwarranted. The investment for purifying equipment may be assumed at from \$15 to \$75 per 1,000 cubic feet capacity per day. A fair average investment charge will be, say, \$30. Operating expenses, where oxide is used, will vary from, say 0.1 to 1 per cent. per 1,000, and probably 0.25 cent can be taken as an average in well regulated plants. We will assume the average gas company must sell its bonds on a 5.5 per cent. interest basis and our depreciation is 2.5 per cent. Then assuming an investment of \$30 per 1,000 cubic feet, our fixed charges become $5.5 + 2.5 = 8$ per cent.; 8 per cent. of $\$30 = \$2.40$ for 1,000 cubic feet per day, or 365,000 cubic feet per year—a cost of $\$2.40 \div 365{,}000 = 0.657$ cents per 1,000. It is apparent that this would be the minimum cost for fixed charges, as we have figured on working these boxes at their maximum capacity every day in the year. This would mean that our output for every day in the year would be equal to our maximum day's output. We know that this is not the case, and as our fixed charges *are* fixed our cost per 1,000 will increase if our output diminishes. The yearly load factor on basis of maximum daily demand would be from 55 to 70 per cent. By this I mean that our yearly output would only be equivalent to approximately 200 days times the maximum day's demand or approximately 255 days times the maximum demand. If we assume a

load factor of 65 per cent. (approximately 237 days at maximum day's demand) our cost becomes 65 per cent. of 365,000 = 237,000 cubic feet and \$2.40 ÷ 237 = 1.01 cents per 1,000 cubic feet purified. If our operating cost is 0.25 cents our total cost becomes 0.25 + 1.01 = 1.26 cents per 1,000, our operating cost being but 18.25 per cent. of our total cost. From this line of reason I conclude (1) that operating costs of purification are already so low as to be of minor importance; (2) that our most rigid attention should be directed towards reducing our investment for a given capacity. As an example we can afford to increase our operating expenses 100 per cent. if that will permit us to reduce our investment expenses by 25 per cent. This would result in about the same total cost for purification.

No. 29. How can exhaust steam be most advantageously used?

V. L. Elbert:—For heating and condensation, being used again in the boilers.

F. M. Travis:—For heating buildings for gas holders. In large works where water can be obtained easily engines running condensing through the warm months and exhausting into the heating system during the winter, will show economical working.

C. L. Steenberger:—Exhaust through feed water heater, then to water in holder tank to prevent freezing.

F. W. Stone:—In a small works to heat the exhauster, purifier and meter rooms, and the water in the holder pits.

Fort Madison Gas Light Company:—At a New England gas and electric plant we used the exhaust steam from a 35-horse-power Atlas engine, driving the blast fan for the water-gas machine to heat the plants during the day time in winter. We used the exhaust steam for heating the oil and also for heating the feed water for the boiler.

Editor:—The contributors to this question have not called attention to one way of advantageously using exhaust steam. It can often be more profitably used as a substitute for water in your bench furnaces than in any other way. As a rule gas engineers are brutally uneconomical in their use of steam in spite of the fact that they can afford to use higher class apparatus than most other industrial plants. Most of their steam apparatus runs 24 hours per day, and interest and depreciation (figured at 5 + 5 = 10 per

cent.) on an extra investment of \$20 per horse-power for the purpose of additional economy would therefore amount to 10 per cent. of \$20, or \$2 per year, which divided by $24 \times 365 = 8{,}760$, is equivalent to only \$0.000228 per horse-power hour. These fixed charges would amount to 24-tenths of this for a plant operated only 10 hours per day, which would be \$0.000548. Many electric plants average less than the equivalent of 4 hours per day at full load, so these charges on a 4-hour basis would become $24 \times 0.000228 \div 4 =$ \$0.001368 per horse-power hour. The total amount of steam used in a gas-works is small and therefore the waste is small in the aggregate although enormous in percentage. Conduction of steam about a gas plant is a nuisance outside of the enormous waste. I believe there are greater opportunities for steam economies than in any other branch of the gas business. One gas-works now being erected will almost entirely supersede the use of steam for power purposes by the use of electrical power generated by gas engines. The question of steam economies should be taken up at some future time by this Association.

M. B. TUTTLE:—We use the exhaust steam from our coal-gas exhauster under the grate bars in our three-fourths-depth generator furnaces.

MR. DOHERTY:—The next question in popularity is:

No. 39. Is the manufacture of coke-oven gas now on a satisfactory working-basis?

O. O. THWING:—I am totally unacquainted with the present status of the coke-oven gas industry. I was informed very recently, however, by a gentleman who is connected with the foundry business that he had been obliged to discontinue the use of coke from one of these concerns and go back to the oven coke. He gave two reasons. First, that the coke was too soft to hold up the iron, thereby preventing a proper working of the cupolas and a uniform melting of the iron. Second, that the amount of sulphur in the coke did not run at all uniform and frequently exceeded the limit that good foundry practice fixes.

GEO. WHYSALL:—Yes.

ORAL DISCUSSION.

MR. DOHERTY:—Mr. Andrews' answer to this question miscarried by mail so that it could not be embodied in the written report, and therefore I will ask him to give it orally.

President Andrews:—Pardon me for addressing you from the chair. The opinion expressed by Mr. Thwing is probably due to some poor quality of coke received, owing to troubles which all coke ovens have had this winter, especially by-product coke-ovens, but as a general proposition there is no trouble with coke for foundry use. It is being used very largely and more largely every day, as the data which was read to you a short time ago will illustrate. The use of by-product coke ovens is extending wherever the conditions are such that coke can be satisfactorily and profitably sold and a supply of coal can be assured at all times. The balance can be used if the gas can be taken care of, and the town is large enough for it. The fact that so many plants are going up is of itself evidence of this fact.

Mr. Twing:—In my statement, Mr. President, I believe I did not express any opinion at all, but simply reported the facts as they were reported to me.

Mr. Doherty:—The next question is:

No. 58. Has anybody had any experience in extracting sulphur from gas made from coal containing 6 per cent. of sulphur, using three or more washers and iron oxide to perform the work?

B. E. Chollar:—I know of no one who has had experience in extracting sulphur from gas made from coal containing 6 per cent. of that substance using three or more washers and iron oxide. The only way I have myself been able to handle gas from such has been to use lime and change purifiers, not by chemical test, but by meter indications.

K. M. Mitchell:—It cannot be done. I have tried it.

ORAL DISCUSSION.

Mr. Bredel:—I had some experience with the native Illinois coal, at Aurora. I used three washes—actually three washes, but which are practically 15 washes and we found with apparatus of a nominal capacity of 250,000 feet that the apparatus would handle 185,000 feet satisfactorily, and that coal probably contained 5 per cent. or more sulphur. I do not know any more about it.

Mr. Doherty:—How did you take care of the CS_2?

Mr. Bredel:—It seems to wash out. What sulphur compounds are formed there we do not know and I do not think anyone else knows. But the fact of the matter was that the gas in

the washers after passing the washers and the oxide purifiers contained only 22 to 23 grains of sulphur. The temperature of the first washer was about 100 degrees. There might have been a rising temperature there caused by friction. Of course, we cannot tell that, but the fact of the matter is that the gas about leaving the washer was hotter than when it entered the washer; probably 5 or 6 degrees.

MR. DOHERTY:—I would like to ask Mr. Bredel if a certain portion of his CS_2 was not removed in his fouled iron oxide boxes?

MR. BREDEL:—I do not think so, for the reason that in making some very extensive tests in Erie, Pennsylvania, on the subject of sulphur, the results obtained by using the best Pennsylvania coal brought the total amount of sulphur in the gas before entering the purifier down to less than eight grains, which showed that quite a little of the bi-sulphide of carbon was removed. I do not recall exactly what it was, but that is as I remember it; there were practically 15 washes and not three washes.

MR. DOHERTY:—If we can get Mr. Bredel to tell us about the method used in Aurora, Illinois, and Erie, Pennsylvania, I cannot imagine a more desirable contribution to our proceedings than that. I know that he is a master of this situation if anybody is.

MR. BREDEL:—The gas was passed, first, through an air condenser, and the outlet temperature was kept as much as possible between 95 and 105 degrees. Then it entered the first washer, consisting of five compartments, practically five washes; then the second washer, consisting also of five compartments, or five more washes. The gas then passed through a water cooler, and at last through another washer to take out the ammonia. The liquor from the last washer, in fact, from all the washers, flows into a separator which separates the ammoniacal liquor from the tar and the light oils mechanically taken along. Then the liquor is pumped over into the lower part of the last washer, and a great quantity, probably 10 to 12 gallons per 1,000 feet of gas made, is pumped over in the second and first washers. The one that took out the most sulphur compounds—the sulphur compounds were taken out—was the first washer; while the second washer took out the most carbonic acid, and, paradoxical as it may seem, the first washer took quite a lot of ammonia out, while the second washer did not, and the last washer finished it. That is the process.

MR. DOHERTY:—I would like to say just one word on this subject. I suppose the ammoniacal liquor in the presence of the immense amount of CS_2 would form bi-carbonate of ammonia rather than ammonia and sulphur compounds, and you have to get it to about 140 degrees apparently to decompose your bi-carbonate of ammonia, and I thought the ammonia had a greater affinity for carbonic acid than sulphur, and the result of some work I have done would seem to bear that out.

MR. BREDEL:—I do not understand exactly about that. The only thing I know is that the first washer took out more sulphur and the second washer more carbonic acid.

MR. DOHERTY:—I assume you were working on the first scrubber above the decomposition point of bi-carbonate of ammonia?

MR. BREDEL:—If I could get inside of the washer I could find out very quickly.

MR. HARROP:—I should like to ask Mr. Bredel what test he used for arriving at the amount of carbonic acid and sulphur compound?

MR. BREDEL:—In the combustion test for sulphur compounds and for the carbonic acid we used first a small laboratory-purifier apparatus, and then determined the carbonic acid in the usual way by potassium hydrate.

MR. DOHERTY:—The next question is another purifying-house problem:

No. 11. What substitutes can be advantageously used for shavings or sawdust in purifying material?

V. L. ELBERT:—How would spent tan bark do? There may be an acid in this that would hurt the chemical action of the gas. Personally, I do not know. Or how would a percentage of small bright gravel or stones, say 0.75 of an inch in diameter, do? With the use of moisture in the box they would, I believe, arrest portions of the cyanides, and at the same time separate the iron. The weight, however, of such material would be an objection.

C. E. BURROWS:—If I could not get shavings or sawdust I would try hay or straw, cut up as a farmer cuts it for feeding.

C. J. FOX:—Use lime.

O. O. THWING:—I do not know of any substitute, considering cost and facility of obtaining, that could be advantageously used for this purpose. I have tried but one substitute, which was very fine screened coke, about the size of a pea. This worked fairly well for a few months and then "went to the bad" with wonder-

ful and annoying suddenness. A large part of the oxide had undoubtedly entered the pores of the coke and the gas could not come in contact with it. This experience has convinced me that a proper carrier of the oxide must not only be able to form a porous mass, but must be permeable to the gas in itself, the same as shavings or planer chips are.

GEO. WHYSALL:—Ground corncobs or chopped corn stalks.

M. E. MALONE:—Ground cork makes an excellent substitute for shavings or sawdust in the preparation of purifying material, and is superior in many respects to either. It is made from waste cork, and can be procured from any of the cork factories. It should be ground to about the size of a grain of corn to obtain the best results.

Cork does not become saturated or soggy.

Cork does not "cake" in the box.

Cork does not become pulverized like sawdust or shavings.

Purifying material made from ground cork, owing to its spongy nature, does not become as compressed as other materials.

Purifying material made from ground cork causes only one-third the back pressure of other materials ordinarily used.

Fifty per cent. more oxide can be mixed with ground cork than with a given volume of the ordinary sawdust and shavings mixture, hence, you increase the capacity of your box 0.5, or purify 50 per cent. more gas with a given volume of the cork material.

The initial cost of the cork is greater than that of the sawdust or shavings, but this is more than offset by its other merits.

Ground corn cobs, it is thought, will also make a good substitute for use in purifying material. Experiments that are being made with ground corn cobs would indicate that they possess many, if not all, of the merits of ground cork.

The ground corn cobs cost about 50 per cent. less than the ground cork, which is an important item.

The following tabulation gives the weight of one bushel (2,150 cubic inches) of different purifying materials:

Purifying materials.	Weight; Lbs. Per Bushel.
Pine shavings	5.25
Ground cork	6.00
Pine sawdust	12.75
Ground corn cobs	15.00
Iron oxide	112.00

ORAL DISCUSSION.

MR. DOHERTY:—I might add in connection with this matter that the first time I heard of this question was in a certain gas plant where they had trouble getting suitable sawdust or shavings. As the boxes were small the purifying material had to be handled very frequently. The result was that it would soon work up into a fine powder, as you all know shavings will do if they are handled frequently. To overcome this difficulty, I had used cross-cut sawdust in preference to the shavings, but that soon became water-logged and I turned around to Mr. Malone and asked him what substitute we could use. He said cork. I said: "It is too expensive." He said: "Ground corn cobs." I said: "Now I believe you have hit it." We inquired into the cost of cork and we found that while it cost a great deal per ton it did not cost a great deal per bushel, and it maintained its elasticity in the purifying box. I do not know how long we have had it in use, but for several months, and we cannot notice any depreciation in it. I do not know how far the ground corn cob experiment is along, but we are going to give that a trial and see if that is not a desirable substitute for shavings and sawdust.

The next question, according to the list here before me, is:

No. 424. What is the usual practice of gas companies when notified by the Gasfitters' Union that eight hours will constitute a day's work.

GEO. KIRK:—Gracefully submit.

HENRY B. LEACH:—We have just been notified that we must recognize, and our men join the union, or the use of gas will be tabooed by the members thereof; no attention has been paid to the threat, and none will be at present.

ORAL DISCUSSION.

THE PRESIDENT:—No doubt some one has had some experience on this subject. Mr. Perkins, have you had any experience on this subject?

MR. PERKINS:—We have not, Mr. President. We have a good feeling of fellowship between the labor unions and ourselves.

Mr. McIlhenny:—Cannot the President give us a little information on this line in regard to labor unions and boycotts?

President Andrews:—I do not know of anything particular within my experience that would be of benefit to you. We have never had any special trouble with labor unions for the reason that we have always kept our men on higher pay than anybody else would pay, and as a consequence they would rather stay with us than join the labor union and receive less pay. We have found that it is more profitable to pay a little more than anybody else and get a little more work out of the men than to establish the labor union standard of wages and put up with the other troubles which follow it.

Mr. Doherty:—The next question is:

No. 15. How large must a gas-works be to warrant the adoption of charging and drawing machinery?

H. A. Carpenter:—Any retort house whose eventual capacity will reach 500,000 cubic feet per 24 hours can well afford to install power charging and drawing machinery, and on this basis the gas company can afford to put the machine in when their maximum make would run to one-half this quantity.

R. B. Brown:—I believe that entirely aside from the labor question power charging and discharging machinery can be used in any single stack retort house with a maximum output requiring six benches of sixes. This is assuming the use of the West combined type of power charger and discharger, which has a capacity of about 16 benches of nines and requires but one man per shift for its operation, and on the assumption that one of these machines with its necessary compressor equipment, overhead hopper and coal elevator could be installed at the particular point in question for $20,000, allowing 10 per cent. for interest and depreciation other than that taken care of in the ordinary repairs, wages of the two men to operate (assuming that the compressor would be taken care of by the boiler man who would be on the plant anyhow), and that the six-bench plant would be operated at a capacity of 200 days maximum per year, or say 72,000,000 cubic feet per annum, with one extra man on the floor for each shift to care for pipes, etc., and the same allowance of men otherwise as for hand labor, the machines would work out to about 8.5 to 9 cents per 1,000 for retort-house labor.

Now I believe that there are more plants of this size operating with all hand labor in which the retort-house labor runs over 10 cents than under 10 cents, and yet I also believe that they can be operated on 9 cents, and therefore state it as my opinion that the smallest number of benches which can be operated with power machinery is six benches of sixes. On anything above that the power machinery will show a saving over hand labor.

There are, however, made in England several types of manual charging and discharging machinery which may be installed at a very much smaller capital and do away with from 30 to 50 per cent. of the men required in a small retort house. These machines can be used to advantage and at some saving in cost on any retort-house employing over three benches, and for houses which will probably never exceed the equivalent of 10 benches of sixes, they are probably better adapted than the power of machinery.

Either type of machine has besides those enumerated the very decided advantage of being able to charge the retorts fully up to their capacity, and to draw them without excessive labor on the part of the attendants, thus increasing the output per retort without increasing the other commensurately.

K. M. MITCHELL:—The writer has had no experience in the working of stoking machines, but believes that recent inventions in this line, and the condition of the labor question must attract the attention of the management of medium-sized gas-works.

Very recently a combined charging and drawing machine has been put in operation in England which promises to fill the wants of medium-sized gas-works of a capacity of 150,000,000 to 200,000,000 cubic feet per annum. The machine is operated by one man, who draws and charges the retorts, one man opens and closes the lids. The cost of operating, including furnace men, bringing in coal and taking out coke, is about 30 cents per ton of coal carbonized. The cost of the machine is about $9,000. Cost of bins, coal breakers and conveyors will be about $4,000, making a total cost of $13,000 per complete installation for 12 benches of 6 retorts (capacity of machine is estimated at 20 benches). The saving in labor (with machine over hand labor) would be 50 cents per ton of coal.

In a works carbonizing 21,900 tons of coal per annum, using a stoker and drawing machine, we have:

A saving of 50 cents per ton		$10,950
Depreciation 8 per cent. of $13,000	$1,040	
Interest at 5 per cent	650	
		1,690
Saving, machine over hand labor		$9,260

From the above figures it is apparent we should be looking into the matter of stoking machinery. Our authority, who is operating a medium-sized gas-works, said: "It costs very little more in summer time working eight benches than when operating 12 benches."

GEO. WHYSALL:—The plant must have a capacity of at least 1,000,000 cubic feet of gas *per diem.*

ORAL DISCUSSION.

THE PRESIDENT:—Mr. Miller, can we hear from you on this subject?

MR. MILLER:—In answer to that question I would say 40 retorts; five benches of eights or seven benches of sixes.

MR. DOHERTY:—This next question, perhaps, it might be well to read at this time in connection with question No. 15, and the two questions can then be discussed at the same time. I will now read question 16 and the printed discussion following and then we can discuss questions 15 and 16 together.

No. 16. What saving can be made by machine stoking and drawing?

H. A. CARPENTER:—Question No. 16 can be no better answered than by referring the Association to pages No. 1607 to 1610 of the *Journal of Gas Lighting,* December 16, 1902, which gives some very conservative results carried out to tons per man. These figures are given on a minimum number of 10 benches making about 8,000 cubic feet of gas per mouth-piece per 24 hours. The possible saving can readily be derived from comparison of these figures with results that any of the members are obtaining.

GEO. G. RAMSDELL:—The cost of all labor in a retort house figures out about as follows:

Slopers, 2.75 to 4 cents per 1,000.

Horizontals with charging and drawing machines, 3.75 to 4.5 cents per 1,000.

Discharging machines only 6 to 7 cents per 1,000.

Manual labor, 9 to 10 cents per 1,000.

ORAL DISCUSSION.

MR. MILLER:—It seems to me the manner of stating the cost as it is stated in the written responses to these inquiries is very indefinite because some plants pay a different price from others for labor. One plant may be paying $2.50 a day, and another plant paying $2 a day for the same work, so that of course the comparative cost would not be the same. It seems to me to compare machine stoking with hand work we should take the number of tons of coal carbonized per man in figuring the cost of labor. If the cost would be about 10 cents per 1,000 and wages $2 per day, each man would be carbonizing two tons of coal. Our experience with stoking machines is that we can carbonize on an average about six and one-fourth tons per day per man throughout the year. That is taking the coal in the retort-house bins and then to do the remainder of the labor and place the coke bins ready to be delivered to the wagons for market.

MR. BREDEL:—I did not have very much to say about it, but if you want to know where Mr. Ramsdell got his figures, I wish to state that I made them up myself years ago.

MR. DOHERTY:—You have changed your mind since, haven't you?

MR. BREDEL:—No. The labor we are figuring on, if I remember correctly, was $2.50 and $2.75 per day. That is all the information I can give.

MR. DOHERTY:—There might be a chance for argument here. Mr. Ramsdell's figures, which come originally from Mr. Bredel, gave a lower cost for slopers than they do for charging and drawing machinery.

Mr. Ramsdell gives the cost of slopers at 2.75 to 4 cents per 1,000 and for horizontals with charging and drawing machines, 3.75 to 4.5 cents per 1,000. The minimum and maximum for drawing and charging machines both being higher than the minimum and maximum for inclines.

MR. BREDEL:—That is not very much difference. There is possibly only the saving of a third to a half cent in using inclines over horizontals, and that is all it gives here.

MR. DOHERTY:—The next question is

No. 12. What are the arguments for and against the use of air in purification?

V. L. ELBERT:—With adequate area of surface exposed where three boxes are in use (one box idle), the material can be practically used up to as high as 50 per cent. of sulphur with the use of 2.5 per cent. of air and no dumping of boxes necessary until material contains the sulphur as stated.

B. H. PETLEY:—As an argument in favor of constant revivification by the introduction of air at the inlet of exhaustion I will state that during the eight months from April to December, 1902, we passed upwards of 150,000,000 cubic feet of gas without changing a purifier, nor did we experience any serious trouble from back pressure caused by the caking of the materials in the boxes. Previous to this run we averaged a change about every two weeks.

FREEPORT GAS LIGHT AND COKE COMPANY:—From our experience all arguments are in favor of the use of air. One and one-half per cent. of air will add 25 per cent. to the purifying capacity.

ALFRED E. FORSTALL:—Reference: *Progressive Age*, Vol. 19, page 267.

EDITOR:—There are objectors to the use of air to extend the life of purifying materials without changing, but I have been unable to get the views of any of the opponents of this plan. Those contributing seem to all favor the use of some air. If air is going to be used, I recommend an arrangement of a small forge blower belted to the exhauster. This is the only satisfactory means I have ever been able to find.

O. O. THWING:—I know of no arguments against the use of air in moderation, in purification. The arguments for its use are too well known to need repetition.

MR. DOHERTY:—The point I was trying to make was that a great many of the difficulties in the use of air, so far as my experience extends, have been in trying to introduce a certain amount of air and overdoing it. I remember one town I was in where the gas was blue, had no illuminating value at all. I became acquainted with the gas man the next day and found that he had slipped a cog on his introduction of air. I have never been able to find a more satisfactory method than the use of a small forge blower belted to the exhauster.

MR. STONE:—I happen to remember that up at Pittsfield, Mass., I saw a scheme where one of the old-fashioned water-seal meters was fastened to the station meter and so arranged by a set of changeable gears that the meter would pump in any quantity of air back of the purifiers, just in proportion as the station meter ran. The faster the station meter ran the faster the old water-seal meter ran to pump the material in, admitting air for revivifying the oxide in proportion to the amount of gas manufactured.

MR. HARROP:—I think Mr. Thwing's answer covers the whole subject pretty well when he says that he knows of no argument against the use of air and the arguments for its use are too well known to need repetition. The use of air is getting to be pretty general these days, so that it is unnecessary to argue for it. I might mention the arguments against it, which I presume are also well known. To make it a matter of record, in order to make these answers complete, I will state that the chief objection is the introduction of nitrogen into the purified gas. For every volume of oxygen there is about four volumes of nitrogen and the gas is diluted to that extent. Then, it is impossible to regulate the air by methods ordinarily used, in order that there will always be just enough air supplied to suit given conditions. Mr. Stone has mentioned a very ingenious method for approximating this regulation, but it seems that where the air is sent in even through a meter, so that daily reports show the proportion of air to gas used, the man who has charge of this will not obey instructions and will send in air in proportions sometimes that are not what is necessary, and sometimes are away below what is necessary, and if they are held down to a certain fixed percentage or if they have orders to send in a certain number of feet of air every 24 hours they will usually allow the air to get in at a certain rate and they read the meter and find if they are getting behind or getting ahead of the amount that should be admitted, and either shut the air off entirely or open it entirely, and they do that in such a way that there is no definite regulation. If the amount of air is more than is necessary, of course there is a percentage of oxygen carried over into the gas, and the gas suffers very largely by that condition. One editor suggests the addition of the air under pressure. I might say that we expect in Milwaukee to adopt a new plan of cyanide recovery, and if we do that we will not be able to drive the air into the

gas by the exhausters as we do now, because we will not want any air mixed with the solutions that are used in recovering the cyanide. The oxidation to a higher state will give us a large proportion of insoluable compounds while we intended to go after the soluble compounds.

MR. OSBORN:—The method I have seen used most generally is something similar to that Mr. Doherty has mentioned. We take pressure from the blower, which runs probably 16 or 18 revolutions per minute, and it is passed through a meter into the inlet of the exhauster and the proportion is kept up by showing the amount of gas passed through the exhauster and watching what goes through the meter. Of course that varies a little, but I have never noticed any bad results from it. We are using about 1 per cent.

MR. STONE:—The scheme I saw in use at Pittsfield, Mass., made the amount of air that was admitted arbitrary. There was no variation. The men could not change it at all. There were gear wheels that the superintendent could change on the station meter and also on this small meter, but if he changed the gear wheels that was all there was to do. There was no other change at all. It simply had to pump just that much air into the gas.

MR. DOHETRY:—Mr. Osborn's remark, saying that they "admit 1 per cent." reminds me of Mr. Chollar's very fine distinction—"we admit 1 per cent." He might put in 2, but he would only admit, or own up to, 1 per cent. This, I will explain, is intended only as a play on words.

STANDARD SIZES FOR GAS METERS.

MR. DOHERTY:—I have one or two more questions which the members have signified a desire to discuss. I will bring them before you and then quit. I think we have discussed about 20 questions in the order of their preference. In the answers to question No. 120 will be found some data relating to gas meters, and, by the way, some of this data may not be very accurate. It had to be compiled very hurriedly, and there are a great many mistakes in it. A study of this data, however, will show that the present rating of gas meters is purely arbitrary and not even right comparatively. It amounts absolutely to nothing. For instance, in some of the tests I had made to check up the figures I made, a certain manufacturer's meter was the same size whether you put on a 20 or a 30 light. The 30-light meter was rated at

a little increased cost and had a different label, but otherwise you simply paid a little more money for a different label. We have outgrown the old rating for meters, and I think some better terms should be used to designate capacity. That is, I mean, we have outgrown the old rating of meters by lights, and I think that this is one subject upon which the gas fraternity needs reform. At least the gas fraternity wants to know what they are buying when they buy a certain sized meter. Most of the gentlemen in this room believed when they bought a 10-light meter they were buying a meter three and one-third times bigger than a 3-light meter. That is not the case. They are buying a meter not quite of double the capacity of a 3-light meter. Take the data referred to, and you will find some interesting figures on capacity per light. You will notice that a 20-light meter is almost the same capacity for all makes as a 30-light meter. The capacity of a 20-light meter is comparatively 240 feet gas per hour at this particular differential pressure that this investigator subjected it to. Now, you will notice the capacity of one make of 30-light meter is only 270 feet; in other words, it is only a little more than 10 per cent. difference in capacity, but your capacity per light, according to these differential pressures, varies from 23.4 for a 3-light, and 25.2 for a 3-light to 25 feet for a 5-light, and 12.5 feet for a 10-light, and 9 feet for a 30-light meter, and 11.5 feet for another 30-light meter, and 10 feet per light for a 45-light meter, and 8.3 feet per light for a 60-light meter, and 8.5 feet per light for an 80-light meter, and 7.2 feet per light for a 100-light meter, and 7.8 feet for 150-light meter, and 7 feet per light for another 150-light meter, while the 20-light meter is 20 feet per light. In other words, it is apparent from these figures that the rating on a meter never did mean anything, in the first place, and in the second place, we have outgrown it; therefore, I think some better term should be used to designate capacity, and it would also be desirable to have meters of standard dimensions, and especially with uniform distance between inlet and outlet connections of meters of the same size. There is a marked tendency all over this country to adopt iron meter connections, and it would be very desirable if we could get meters of the same size—the same distance between centers—so that we would not have to use an offset joint for our iron connections.

I therefore move that a committee of three be appointed to take up this subject with the meter manufacturers, and secure a

new and rational rating of meters, to be of uniform dimension, and to be covered by a new price list, which shall bear a more exact relation to the cost of manufacturing the different sizes and their value to the purchasing gas companies.

Mr. Jones:—I second the motion.

President Andrews:—Are there any remarks? I am sure we would like to hear from some of the meter men on the floor of the convention, if they have any views to express on the matter.

Mr. Doherty:—I would like to know how they can explain it.

Mr. McIlhenny:—I would say, Mr. President, that they explain it in the same way that a great many other things are explained which started with the inception of the gas business. This method originally served its purpose very well, when first introduced. A light was supposed to mean 6 cubic feet per hour. We have changed from the old system of wet meter to the dry meter. The dry meter having a greater capacity than the wet meter, although of the same size. For that reason the name has remained the same as a nominal term, while as a matter of fact the capacities have differed greatly. I do not know that there would be any objection to changing it except that there would not be any uniformity even after the change. Very many gas companies have thousands of meters in use and the new meters which they would obtain would simply have a different nomenclature from the others and which would lead to more or less confusion. It is simply a question whether the effort at reform would be worth the resulting confusion. The meter manufacturers can very easily adopt a table which would indicate exact capacities. In fact, most of the gas companies have that information anyhow. The whole question resolves itself into a solution of the problem whether the benefits to be obtained would be worth the confusion which would result to the gas companies.

Mr. Doherty:—Before that question is put I will say that every man in the employ of a gas company has to be educated to that table, and he has to be able to carry that table in his head and tell what sized meter to set for a particular place, whereas, it would be a very easy matter to designate that meter in such a way that it immediately conveys the information desired. This reform would be along the line of reforms in all similar branches of gas engineering. The whole idea of most of these reforms being to eliminate as much as possible from a

man's memory, which we all know is not infallible, and to get definite and accurate information, as well as uniform and standard appliances. I see no reason whatever for preserving the old rating which we have outgrown. In the meantime, we have departed from a 6-foot standard referred to by Mr. McIlhenny. I think the standard would have to be more nearly 3 feet now.

Mr. Claxsen:—Your idea, then, would be not to designate it by a number of lights, but so many feet per hour?

Mr. Doherty:—Designate it by its capacity in some way.

Mr. Barnes:—As stated by Mr. Doherty, there is very little determinability simply by lights or in given units such as existed at the time Mr. McIlhenny refers to when meters were first given names. It was simply a distinction, as I understand it. Where you are supplying Welsbachs or supplying heat your standard of meter sizes, based on lights, is of no use to you at all in determining how much gas you want to use for a specific purpose. The difficulty might be remedied by establishing some standard, making it conform to the uses that gas is put to, as, for instance, so many feet per hour.

The motion above made and seconded was then unanimously adopted.

President Andrews:—I will appoint this committee to-morrow.

UNIFORM SYSTEM FOR MAPPING GAS MAINS.

Mr. Doherty:—I have two or three other matters to be brought up, which are referred to in the question box. In the question of mapping mains, for example, I find that there is no uniform system of mapping mains in vogue, and I suggest that this Association take it up and try to devise some system for the mapping of mains that is capable of universal adoption. No two companies, as a rule, use the same methods of showing the size of pipe. We do not use the same symbols for the "specials," in fact there is no uniformity whatever on the subject. There is probably some best system in use right now, and if there is not some best system in use, then some best system can be evolved. I, therefore, move that a committee of one be appointed to whom will be assigned the task of working out a uniform system of mapping mains, and to report at the next annual meeting of this Association.

The above motion was then duly seconded and unanimously carried.

STANDARD SIZES FOR COKE.

MR. DOHERTY:—Now on the matter of coke. As you probably know, most of the appliances in which coke is burned were designed originally for hard coal which comes in certain sizes. These appliances are adopted to the different sizes of coal. These sizes of coal are universally designated by some name and if a man moves from one town to another and calls up a coal dealer and wants a certain sized coal to be used in a certain sized stove he gets it. But if he wants to burn coke, perhaps he does not know exactly what he wants, and the result is that he uses coal instead of coke. I have in mind an instance which recently came to my notice where in a comparatively small town they were selling coke below the market price at least $1 a ton, basing it on what was being done in other similar towns, and from then on up to $2 per ton. Now $1 perhaps does not look as if it would make much difference, but it means about 6.5 cents per 1,000 feet of gas. As far as I could learn the coke market was not developed in most of those towns because they did not properly cater to what the trade wanted, and the trade was not going around saying what they did want; they simply used coal. I think it would be to the advantage of all of the gas companies to have this subject investigated thoroughly and a report submitted, giving the most desirable sizes of coke to be furnished for the market, and fix upon names which can be made uniform for its designation.

I therefore recommend that a committee of one be appointed to devise the most desirable sizes of coke to be furnished for the market and to fix upon names which can be made uniform for its designation, and I recommend that this committee report through the gas light journals by September of this year. I would like to see Mr. Andrews upon that committee. He is devoting almost his entire time to the coke business. I will, therefore, move that a committee of one, consisting of Charles W. Andrews, be appointed to investigate and report upon this subject.

The above motion was then duly seconded and, being put to the house by Vice President McIlhenny, was declared unanimously carried.

On motion, duly seconded and carried, the Association then adjourned until Thursday, March 19, 1903, at 9:30 A. M.

QUESTIONS NOT ORALLY DISCUSSED.

No. 1. Why do we use lump coal when we can buy slack or run of mine cheaper?

J. H. Enright:—I am unable to see how any manager cannot see the great advantage in using slack coal under boilers in preference to lump for several reasons, the principal one being that when boilers are kept clean, and closely looked after with a properly constructed furnace and intelligent firing, one can easily get along with less than one-half the cost as compared with the cost of lump coal for fuel.

G. N. Clapp:—In answer to this question, there are several reasons:

(1) There is more waste in handling slack.

(2) It requires higher heats to carbonize.

(3) It yields less per ton purchased, on account of loss in handling. The freight and carting cost the same as lump coal. I think in some cases, where stoking machinery is used and there is no carting, it may be different.

V. L. Elbert:—(*a*) If favorably situated in relation to mines, run of mine would give about same yield, but requires more heat to carbonize, hence more fuel.

(*b*) Where coal must be stored in large quantities to carry over the winter or any other period, the loss is heavy in yield of gas after 60 days' storage.

(*c*) You are also endangered from spontaneous combustion to a much greater degree with slack coal and run of mine than with lump coal.

J. T. Mason:—There are several good reasons why we use the lump coal (when we can get it) instead of slack or run of the mine. The lump coal will store better in the shed or hill; it loses less of its gases while stored; it contains as a usual thing a smaller percentage of ash; it takes up moisture more slowly; and it is more easily dried.

When taken into the retort house for carbonizing, the greatest difference is to be seen.

Take two benches along side of each other, and charge one with clean lump coal and the other with the slack or run of the mine. You will see these differences. The bench using the lump coal will carbonize more coal per retort to the pound of fuel used and in a shorter period of time. The lump coal lies

loose in the retort so that the heat will reach the center of the charge quicker than it will with the slack or run of the mine; which will lie in one close mass, containing more moisture to be driven out before the heat can act on the coal itself. The lump coal will yield its gases easier, and more of them. The coke that cokes from it will be of much better grade than the other.

The two charges when drawn (if drawn at the same time) will look about the same when the lid is opened, but when charge is broken by the rake the lump charge will be found clean and the coke bright with no flame. The heart of the other will be found dull and the chances are that there will be plenty of flame.

The one retort will be hot, ready for the next charge, and the other dull and in poor condition to receive another charge of slack or run of mine. The lump coke will retain its size to the pile, where the slack will be broken, and when the stock is figured there would be a large percentage of breeze.

J. W. Reilly:—Screened or lump coal gives better carbonizing results than run of the mine. The latter is not only harder to burn off, owing to the dust contained in it which forms in the retorts a compound mass through which the heat cannot pass or penetrates slowly and with difficulty, but also contains more dirt and slate and a large percentage of sulphur, and will not yield as much gas even when thoroughly carbonized. A majority of coal-gas companies buy from 0.75-inch to 1.5-inch screened coal. The larger the lumps the better, and besides you get a better quality of coke. The dust makes breeze only. The screened coal will more than compensate for the higher price paid for it.

C. H. Williams:—We buy lump coal in preference to slack or run of the mine because of the excessive freight rates on coal—$1.50 per ton for hauling 138 miles. This fixed cost per ton for all grades of coal leaves a small difference for the coal delivered, so that the increased thermal value of the coal, and the increased weight which can be burned per foot of grate surface, increasing as it does in reality the boiler capacity over what it would be were we using an inferior grade of coal, more than compensates for the extra cost per ton as charged, exclusive of haulage.

C. E. Burrows:—I use lump coal, first, freight on slack is the same as on lump and there is more waste in slack, and cost at mine only 25 cents per ton less, and second, the mine from which we obtain coal will not sell slack, retaining it for caking.

B. H. PETLEY:—Lump coal is generally used in preference to slack or mine run coal because its yield in cubic feet per pound and make per man and per retort is enough greater to offset its extra cost and make its use more economical.

PEORIA GAS AND ELECTRIC COMPANY:—The reason for using lump coal instead of slack or mine run is that it does not require the heat to carbonize coal that has been screened as it does mine run, consequently getting a better yield under lower temperature and less trouble with naphthaline.

THOS. D. MILLER:—Lump coal is used for making gas instead of cheaper slack or mine run because the coal can be charged in such a manner as to produce more and better gas and burns off in a shorter time. My theory is that the slack coal lies so close that the heat does not penetrate rapidly enough to gasify a percentage of the tar, that in the lump coal is gasified. Further the lump coal is always more free from slate and dirt of various kinds. It is often a question of using a coal that would produce the most gas in the shortest time with the lowest consumption of furnace fuel. The coke produced from slack coal on short charges is not as good coke at that produced from lump coal, which is possibly accounted for by the larger percentage of dirt and slate contained in the slack coal not found in the lump.

FREEPORT GAS LIGHT AND COKE COMPANY:—Because it is cheaper, yielding more gas, fewer impurities, and better quality of coke.

ALFRED E. FORSTALL:—References: A. G. L. A. proceedings, Vol. 14, page 28; *Journal of Gas Lighting*, Vol. 78, page 340; *Progressive Age*, Vol. 19, page 368.

WALTON FORSTALL:—References: A. G. L. A. proceedings, Vol. 14, page 28, and Vol. 17, page 132.

EDITOR:—The solution of this question is purely a local matter and yet deserving of serious consideration by many gas companies. The slack of some coals is practically as desirable as lump coal and can often be bought much cheaper. The slack of a good caking coal should make coke equal to or better than the lump coal. As a rule it will not carbonize as quickly, but six-hour charges can be adopted if the difference in price will warrant the increased cost in bench fuel and furnace labor. In some portions of the country lower freight rates can be secured for slack coal and the price of the slack is enough less to warrant its use.

One gas company I know of is so situated that they can buy a large amount of slack coal each year for about 45 per cent. of what they pay for lump coal, but the manager is prejudiced against slack and will not use it.

No. 2. What is the proper method of determining the degree of profitableness of each kind of available coal?

G. N. Clapp:—The most profitable coal is that which will yield the most gas of 17 candle-power and make the best quality of coke, and contains the least amount of sulphur.

V. L. Elbert:—The practical distillation of at least one ton of coal in a small plant..

C. E. Burrows:—By retort test in regular working.

B. H. Petley:—The degree of profitableness of each kind of available coal I believe can best be determined by an actual test of its value to produce at the lowest cost the greatest quantity of gas in cubic feet per pound per man and per retort of the highest quality in candles per cubic foot with the least cost for purification; to produce the greatest quantity of good marketable coke, tar and ammonia by-products available for sale.

Peoria Gas and Electric Company:—We determine the qualify of the coal by test of a week's duration to find yield, candle-power, tar, ammonia per ton of coal and quality of coke.

Editor:—A contribution describing proper method for coal analysis to determine percentage of moisture, volatile matter, fixed carbon and ash was received from J. W. Reilly, of Wilmington, N. C., for which he has my thanks, but to save space these instructions were eliminated, as the same information is available to every gas manager in his text books.

Thomas D. Miller:—Determining the degree of profitableness of each kind of available coal is best accomplished by actual running of the plant on the different kinds of coal for a period of two or more days, keeping careful account of the production of coke, gas, tar and ammonia, and the quality of each. The results obtained by this method are the practical results that would follow the regular use of these coals, and develop the practical difficulties which are likely to arise from the use of the various coals, which would not become apparent in an experimental plant.

Freeport Gas Light and Coke Company:—In small works, run entirely on the coal to be tested from three days to a week, noting particularly yield, candle-power of gas, quality of coke, etc.

No. 3. Assuming that some coal must be stored to insure a supply at the works, is it better to leave the same coal stored all the time for any emergency that might arise, and use fresh coal as far as possible, or is it better to use the oldest coal, and should the old coal be cleaned out once a year?

ERNEST F. LLOYD:—As deterioration in stored coal is a process of slow distillation, it would seem a reasonable deduction that the gas distilled from the outer surface would leave a coating which would impede the deterioration from the interior, and that it would, therefore, be better to hold stock coal in store indefinitely.

GEO. WHYSALL:—Old stock of coal should be cleaned out before using any new, providing conditions for storing will warrant.

No. 4. Does it pay to provide and maintain a small test plant for coal and gas determinations?

PEORIA GAS AND ELECTRIC COMPANY:—It is a good thing to maintain a test plant, especially if you are in the habit of getting various grades of coal which are constantly demanding your attention as to the results they are rendering.

B. H. PETLEY:—I do not think that it pays to provide and maintain a small test plant for coal and gas determinations, because I believe that the proper test of the value of any coal can be made only by the use of sufficient quantity for a period long enough to insure full knowledge of its results under ordinary working conditions.

THOMAS D. MILLER:—It seems the maintenance of a small experimental gas plant would be a desirable thing, and would pay according to the size of the plant and the variety of coals that were available, enabling one to determine by the experimental plant whether any particular coal offered enough to justify his making a practical run on same.

FREEPORT GAS LIGHT AND COKE COMPANY:—Not in small works.

EDITOR:—We have in use a small test plant at Denver, and this question was asked by a gas manager who is considering the advisability of establishing a similar plant. This plant is nothing more than a separate condensing, purifying and measuring equipment which will take care of the gas from one retort whose standpipe is so arranged that communication can be cut off from

hydraulic main and established with testing plant. Very little is known about these western coals, and it was impossible to run off a working test on all of the coals available. This made a small testing plant a very desirable thing. It at least enables us to determine what coals are possible and what coals are impossible. Results obtained in this plant have been very satisfactory. factory.

GEO. WHYSALL:—Yes, where conditions will warrant.

No. 5. How much CS_2 can be removed by the use of foul oxide of iron?

W. B. CALKINS:—Oxide of iron by itself has no affinity for bisulphide of carbon and other sulpho-carbon compounds, but when the oxide is fouled, and full of free sulphur in a finely divided state, it seems to have the power of arresting a part of the bisulphide of carbon. By Mr. Harrop's method of separation and analysis for bisulphide of carbon, we made a test of our crude gas before it enters the purifying boxes, and found 8.1 grains of CS_2 per 100 cubic feet of gas, while a sample of our street gas gave only 4 grains per 100 feet, showing a reduction of about 50 per cent.

O. B. KOHL, C. H. WILLIAMS:—The chemical equation for this is:

$$2FeO + CS_2 = 2FeS + CO_2.$$

The CS_2 passing through the FeO leaves its sulphur, forming ferrous sulphide, and leaving CO_2 as the inert residue.

By weight: $Fe = 56$, $O = 16$, $S = 32$, $C = 12$. Substituting in the above equation we get

$$2FeO\ (112 + 32) + CS_2\ (76),$$

showing that 144 parts by weight will remove 76 parts by weight of CS_2.

No. 6. Is there any short and direct method for determining quantity of CS_2 present in gas?

ALFRED E. FORSTALL:—Reference: Hornby's Gas Engineer's Laboratory Handbook, page 155.

H. B. HARROP:—The following is from a paper I presented last year at the New York meeting of the McMillin Managers' Association, entitled "Rapid Sulphur Determination in Coal and

the Products of Its Carbonization." At the request of your question box editor I have synopsized the part covering the carbon disulphide test.

The method here offered for the determination of sulphur in illuminating or other gases consists in bubbling the gas through two aqueous solutions, one of which contains lead acetate, and acetic acid, and the other the same salt to which a large excess of potassium hydrate has been added. By arranging the train so that the acid solution comes into contact with the gas first, hydrogen sulphide is separated out, and the alkaline solution takes care of the carbon disulphide.

The insoluble lead hydrate formed when the potassium hydrate is added to lead acetate solution is redissolved in adding a further quantity of potassium hydrate. CS_2 is decomposed by this solution even at ordinary temperature, but to get a sufficiently rapid action it should stand above 117 degrees Fahr.; the best working temperature is between 150 and 190 degrees—the higher the better.

$$2Pb\ (C_2H_3O_2)_2 + 4KOH = 4KC_2H_3O_2 + PbO,PbO_2H_2 + H_2O.$$

$$PbO,\ PbO_2H_2 + 2KOH + CS_2 = 2PbS + K_2CO_3 + 2H_2O.$$

If a total determination is wanted it is merely necessary to omit the acid washing, as the alkaline solution acts alike on the sulphur compounds without respect to form. The sulphur comes down as lead sulphide, and after collecting sufficient of the precipitate to minimize errors in weighing, it is separated out on a tared filter and the process is complete. The apparatus can be made in the laboratory in 15 minutes at a trifling outlay from boiling flasks and glass and rubber tubing. The test may be made in a short time, or extended over a long period to obtain average records, according to the particular kind of information wanted, and admits of any degree of accuracy.

The precipitate in both the acid and alkaline solutions is lead sulphide (PbS). If the occasion demands, there is no good reason why the minute amounts of soluble lead salts carried down should not be removed by oxidizing the sulphide to sulphate; further, it is true that careless heating of PbS over a direct fire may convert small portions of Pb_2S with a consequent loss of weight, and that even prolonged heating in a water bath will oxidize the sulphide slightly with a resultant increase in weight. The amount

of precipitate taken may readily be, at will, great enough to minimize such errors to any degree. For the purpose of ordinary work it may be accepted as unreservedly correct that hydrogen sulphide may be completely removed from gas by passing through one or more wash bottles of acid acetate solution, that carbon disulphide has no action in lead acetate in the pressure of free acetic acid at any temperature, that carbon disulphide may be completely and readily absorbed by a hot solution of lead hydrate in potassium hydrate, and that from the precipitates, dried for a reasonable length of time, the sulphur absorbed may be calculated. For a laboratory test of purified gas take two 500 cc. boiling flasks, fit them with stoppers perforated with two holes each, and insert glass tubes (one reaching nearly to the bottom of each flask); fill the flask and connect them to the gas-test pipe so that the gas shall bubble first through the acid solution, then through the alkali, and into a meter; to the outlet of the meter connect a Bunsen burner and place it under the alkali flash at such a distance that the contents shall be kept fairly hot without actually boiling. The temperature may be regulated by a thermometer inserted through a third hole in the stopper, or by noticing from time to time that the surface of the flask is painfully hot to the hand. The apparatus may be left to itself for some hours; or if a rapid, and at the same time very accurate test is required, two or more flasks of each solution may be charged and connected in series, and a considerable stream of gas sent through. In this case it is only necessary to heat the contents of the alkali flasks at the beginning of the test. At the option of the experimenter the acid flask may be heated toward the close of the test to drive over any CS_2 suspected of being held in solution in the water. In the case of properly purified gas the acid flask will show no discoloration whatever, and the sulphide from the alkali flask only remains to be collected and calculated to CS_2.

For testing the behavior of individual purifying boxes or for use on the washers and scrubbers, where more or less ammonia will be encountered, it is essential to include a wash bottle of not too dilute hydrochloric or oxalic acid through which the gas shall first pass before traversing the first lead solution. The acid in the guard bottle should be reddened with methyl orange in order that the operator may be warned of an invasion of alkali. In dealing with gas from the condensers, or earlier, a wash bottle packed

with cotton wool, or some other suitable device for removing suspended tarry matter, must come first of all. Only small quantities of crude gas are required for ordinary tests, and a one-gallon aspirating bottle will be found more than ample for measuring purposes. Where samples are taken from the hydraulic main against the pull of the exhausters some such aspirating device is indispensable.

A word as to capacities: Five hundred cc. boiling flasks will be found most convenient. Rubber stoppers should be used, of such dimensions that there will be no danger of squeezing out of place during the test. The glass tubes dipping into the solutions should reach nearly to the bottom of the vessel, and when the flasks are filled to half their capacity the seals will average about 1 inch, a suitable depth if the number of units employed and the available pressure admit. The operator must take into consideration the approximate amount of sulphur compounds expected, and the accuracy intended, in determining the extent of his apparatus and the amount and rate of gas to be passed.

For ordinary work dissolve about 2.5 grams of lead acetate in 100 cc. water, dissolve three or four sticks of caustic potash (40 to 50 grams) in an equal quantity of water, add the first to the second, stirring meanwhile, filter and make up to about 250 cc. This makes a charge of one flask or may be diluted by adding 250 cc. more of water and charged into two flasks to be connected in series, and so on. For the H_2S absorption a like amount of lead acetate is taken, and only enough acetate acid need be added to maintain in the solution a distinct acid reaction.

The amount of KOH indicated for the alkaline mixture will be amply capable of holding up the lead hydrate in the face of carbonic acid from the gas and from the reaction that will tend to throw the lead out of solution.

Two and five-tenths grams of crystallized lead acetate (sugar of lead) contains 2.144 grams anhydrous acetate or 1.366 grams lead, and forms 1.577 grams lead sulphide, which represents 0.211 grams sulphur or 3.25 grains. This charge will take care of 5 feet of average purified gas with a large margin to spare, or of 0.1 to 0.2 foot unpurified or even crude gas. The precipitate will amount to from 0.5 to 1 gram for the predominant impurity (CS_2 in the purified and H_2S in the unpurified gas); of course the product from the minor sulphur compound will usually be much inferior in amount, and if they are determined separately and

simultaneously this must be taken into consideration. But in general the figures just noted will be found to yield quantities of precipitate more than sufficient to allow even an inexpert operator some margin in his weighing.

The precipitate from the alkaline solution should be washed in the filter with a little dilute acetic acid to remove any lead oxide or carbonate that may contaminate it. If the sulphur found indicates that the solutions have been only in small measure exhausted there is no objection to using the filtrates for further tests. Each gram of PbS found and calculated to 1 foot of gas passing through the test, corresponds to 0.134 grams (2.069 grains) sulphur to the foot, or 206.9 grains to the 100 feet.

No. 7. Has any progress been made in this country towards the commercial recovery of sulphur and cyanides?

V. L. Elbert:—Yes, on the latter. Fred Bredel, of Milwaukee, did have a process in Cleveland for its recovery from purifying material.

No. 8. We find chlorine as ammonium chloride (NH_4Cl) in our liquor. Where does it come from?

W. B. Calkins:—The chlorine that we find in our gas liquor as ammonium chloride must come from the coal. The general accepted theory is that the coal absorbed chlorine salts from the saline waters that covered the coal beds during the carboniferous age. In the retort the chlorine salts are broken up, the chlorine passing off as hydrochloric acid, but the ammonia having the stronger affinity for the chlorine breaks up the acid, forming ammonium chloride, and sets the hydrogen free.

No. 9. How may the quantity of naphthaline in gas be determined?

W. A. Baehr:—The writer has had some experience with such a determination by means of picric acid. The gas must first be freed from tarry and sulphur constituents as much as possible, and is then allowed to bubble through a solution of picric acid, being measured and temperature and barometer noted at the same time. After the required quantity of gas has passed, the

solution is allowed to stand in a beaker kept free from dust in a dry place. In one to three days all the solution will have evaporated, and beautiful long transparent crystals of naphthaline picrate will be found. These are weighed, and the quantity of naphthaline is then calculated. I will say for this method that I am afraid various other substances besides naphthaline are arrested by picric acid, but can at present give no proofs. The method also has the further disadvantage of being too slow for practical use.

ALFRED E. FORSTALL:—References: *Journal of Gas Lighting*, Vol. 75, pages 798, 1,282; *Journal of Gas Lighting*, Vol. 74, page 595; *American Gas Light Journal*, Vol. 72, page 1,016.

WALTON FORSTALL:—References: *Journal of Gas Lighting*, Vol. 75, pages 798, 1,003 and 1,282, and Vol. 80, page 1,277.

No. 10. What is the best method of oxidizing borings and making up purifying materials?

V. L. ELBERT:—Spread cast-iron borings 4 to 5 inches deep and cover the same with 1 inch of coarse salt. Wet the same with water, and when it starts to heat turn the same and break up any lumps with back of shovel. Spread on more salt and repeat the wetting process. If borings look rusty they will need no further salt, but keep wetting and turning until heating of the borings stops. The original 4 or 5 inches should then have swollen 16 to 20 inches in depth. For each ton of the iron take 20 to 30 bushels of pine planer chips or coarse sawdust, and saturate the same with 13 pounds of copperas dissolved by hot water for each bushel of the shavings. Slack about 30 bushels of lime. Spread the prepared iron borings and place the slack lime on top, and cut it over by turning with a shovel. Then spread on the saturated shavings and cut over once or twice so as to mix thoroughly. When thoroughly mixed pile up in cone shape as high as possible. Let the material stand until it gets so hot you cannot hold your hand within a foot or so from the surface of the pile. Material should then be spread out 12 to 16 inches deep to cool, when it is ready for use. If you want quick action in the material add about 10 per cent. of old oxide mixed thoroughly with the material. Otherwise it will not take hold until about the third change of the box.

C. L. STEENBERGEN:—I use one ton of iron borings, 50 bushels of planer chips and one barrel of strong ammoniacal liquor

taken from my tar wells, mixing the sawdust and borings thoroughly and pouring the ammoniacal liquor over the heap, then wetting the whole mass thoroughly with water which oxidizes the iron completely in from 10 to 15 days with one or two turnings.

B. W. PERKINS:—Iron borings can be cheaply and easily oxidized with common salt, which should be mixed with the borings in a dry state, and wet and turned with a shovel daily.

J. T. MASON:—The iron oxide or sponge as it is sometimes called is made of iron borings, shavings, and (as we make it) copperas and lime.

The iron borings are clean, dry cast-iron chips from the planer or lathe. The iron has to be thoroughly oxidized to the form of hydrated ferric oxide ($Fe_2O_33H_2O$), being the form that the iron will react with the sulphurated hydrogen (H_2S).

The shavings or planer chips are mixed so the material will not pack and cause back pressure on the boxes.

The copperas is dissolved in water, and the copperas water is sprinkled on the shavings before the iron is put on.

The lime is slaked to the usual consistency for purifying gas, and then scattered over the sponge last of all.

I shall not claim that this is the very best way of making sponge, but it has given us perfect satisfaction here in Milwaukee.

The way we mix our material is as follows:

The shavings are spread upon the floor just as thin as we can get them, which is about 18 to 24 inches deep. The copperas is then dissolved by putting 0.5 bushel of it in a barrel of water. and then steam is turned in at the bottom of the barrel till all the salt is in solution. It is then taken in sprinkling cans and sprinkled over the shavings. The pile is then turned and the mass sprinkled again. This is carried on till the allotted amount of the copperas is on the pile. The iron borings are then spread over the pile and the whole of it is then wet with water and turned over twice. It is left over night and then wet and turned again. The lime is slaked and spread over the pile, when it is again turned. This proceeding is carried on till the iron is thoroughly oxidized and the oxide has adhered to the chips. It is then left alone till it goes into the box.

One bushel of our material consists of 10 pounds shavings, 20 pounds iron borings, 1.88 copperas, 0.72 pounds lime.

B. H. PETLEY:—As a partial answer I believe that iron borings should be oxidized at the time rather than before making up purifying material, so that the iron in rusting forms a coating on the shavings and is better retained in the material.

PEORIA GAS AND ELECTRIC COMPANY:—We have used concentrated ammonia liquor for rusting borings, with good results.

THOS. D. MILLER:—One method of oxidizing iron borings in the preparation of oxide sponge which has proven eminently satisfactory, is as follows: Seventy bushels of sawdust, 1,000 pounds cast-iron borings, one barrel of salt made into two barrels of brine; spread the sawdust out about 8 inches deep, sprinkle well with one barrel of brine. Spread the borings equally over the sawdust, and sprinkle with one barrel of brine. Leave standing for 24 hours. Then turn over and sprinkle twice daily with water for three days, when it is ready for use. It improves if allowed to stand longer, turning and wetting daily.

After this sponge has been put through a purifying box once it improves very much on reoxidizing. I have used this method for several years, and have obtained unparalleled results with same.

FREEPORT GAS LIGHT AND COKE COMPANY:—Spread 3 inches deep, wet with strong salt water (but not wet enough to cake), wet and turn daily, breaking up all lumps.

EDITOR:—Mixing purifying material is capable of as many modifications as mixing "French Salad Dressing." One error to my mind seems prevalent with most gas companies—too much labor is wasted on the work. Nature will generally work cheaper for six months than a "gas house terrier" will work for one day. If the materials are purchased well in advance they can be started upon their oxidizing process and left for the elements to complete the work. I prefer to rust my borings separately to prevent my lightening material from becoming water-logged before the material is put in use, but I admit that this system often requires more time and is susceptible to other objections. Iron borings spread on old purifying trays supported at their corners with bricks, leaving a 4-inch space below for air circulation, will rust to a fine powder with the help of a sprinkling of salt water or ammoniacal liquor free from grease from time to time. Borings mixed with sawdust or shavings and subjected to the same treatment will oxidize more quickly without caking. Steam below the trays, such as the exhaust from a small pump, will also assist.

The relative cost and desirability of purifying material made from borings and made from sawdust or shavings soaked in copperas water, have never been fully set forth, and an investigation of this matter by this Association might bring out some desirable information.

O. O. THWING:—The most satisfactory method of oxidizing borings and making up purifying material that I have found is to thoroughly mix the borings with the necessary amount of shavings or planer chips before beginning the oxidization. Then we saturate the mixture with a solution of salt in water, in the proportion of about one barrel of salt to six barrels of water. The bed is then turned over, with shovels, daily for three or four days or until the first heat of oxidization has begun to subside, sprinkling the bed with water only, at the same time. After this the bed is turned once or twice more at intervals of a week or more and, when cool, is heaped up and left until required. We make the bed about 16 inches deep at the start. The longer time the oxide can be left heaped up after making, the better results will be obtained upon using.

We have also tried oxidizing the borings before mixing with shavings, but this method has not been nearly so satisfactory as the above. It is almost impossible to keep the temperature low enough when oxidizing the borings by themselves, to prevent overheating and crystallizing the iron and, while the product presents a very handsome appearance, its value for purification is very much below that of oxide prepared by the other method.

M. E. MALONE:—It is advisable to always have on hand a plentiful supply of good, clean, cast-iron borings, free from grease or oil.

The borings should be spread to a depth of 5 or 6 inches on boards or trays raised a little from the ground and then left to rust. Oxidation can be hastened by wetting and sprinkling a little salt on the borings, and turning them frequently. After the borings are thoroughly oxidized, the oxide should be screened through a fine mesh screen, when it is ready for mixing.

The following proportions make a good mixture:

3 bushels coarse pine shavings.

3 bushels coarse pine sawdust.

1 bushel oxide.

Mix them thoroughly while dry, and then moisten with copperas water, which assists the action of new material. It is then ready for use.

When ground cork is used, the proportions should be four bushels to one of oxide, and with ground corn cobs, the mixture should be about five bushels of cobs to one of oxide.

Fort Madison Gas Light Company:—The cheapest method of oxidizing iron borings is to spray the mixture with the ammoniacal liquor from the washer twice each day until the oxide is ready for use. Mix it well after each wetting.

No. 14. How should quantity of sawdust or shavings, for mixing with iron oxide, be determined?

V. L. Elbert:—See answer No. 10, for mixing.

B. W. Perkins:—The quantity of sawdust or shavings could be best determined by the amount of purifying capacity at hand.

Peoria Gas and Electric Company:—We use from 20 to 22 pounds of iron borings per bushel of sawdust or shavings.

Thos. D. Miller:—See answer to No. 10.

Freeport Gas, Light and Coke Company:—By the back pressure caused, we get the best results from 25 pounds of oxide per bushel of shavings.

Editor:—No rule of thumb is applicable for every gas-works. The quantity of oxide used is generally limited by the back pressure permissable. In this case no more shavings or other dilutent (which is intended primarily to lessen the density of the material) should be used in excess of amount required to keep back pressure within the desired limits.

O. O. Thwing:—Our rule in proportioning shavings and iron is to use one part, by volume, of iron to seven parts of shavings. In other words, we prepare a bed of shavings 14 inches deep, then put on 2 inches of borings and mix them thoroughly. The oxide will weigh about 60 pounds to the bushel.

No. 17. Is there any continuous system of carbonizing coal?

Frederic Egner:—I would say that having perhaps traveled in a professional capacity the past few years as many miles in America and Europe as most gas engineers, I have not seen such

a process or yet heard of it. Maybe somebody else has one "up their sleeve" somewhere and your question will—and if so, I hope it may, bring it out.

GEO. WHYSALL:—Yes, an oven process now used in Germany.

No. 18. Are there any new developments in inclined retorts?

GEO. G. RAMSDELL:—Considerable progress in the refinement of inclined retorts has been made in the last few years resulting in the Drakes system, which is now about perfect.

FREDERIC EGNER:—This system has been pretty well perfected years ago. The only thing I saw new within the past year in that line was at Edinburgh, Scotland. R. W. Herring, the chief engineer and manager of that corporation, introduced very small hydraulic rams for the purpose of moving the plate iron slide valves of his coal-charging hoppers, instead of using the long unsightly levers, illustrations of which we are all familiar with.

You will find that device described and illustrated in the *American Gas Light Journal,* page 227, Vol. LXXVII (from July 1 to December 31, 1902).

No. 19. What saving can be made by the adoption of coke conveyors?

R. B. BROWN:—At Milwaukee's Third Ward retort house we figure that it would require six men per shift at $2 per day each, or $24 a day, for hand labor to quench and wheel out coke from 28 benches of nines, and that for half the year there would be required an additional two men on hand on each shift to stack the coke, or an average cost per day of $28 with full-house working, which works out to about 19.2 cents per ton of coke quenched and taken out of the house.

For 1901 and 1902 our actual figures show the Milwaukee conveyors quenched, carried out and stacked the coke at an average cost of 7.6 cents per ton of coke for power, wages of engineers, all attendance, repairs and replacements. The first cost of this conveyor installation was about $5,000, or at 10 per cent. to cover interest and depreciation on parts not being renewed, $500 per annum, or an additional charge on this account of 1.1 cent, making the total cost 8.7 cents per ton of coke conveyed.

W. R. Chester, of Nottingham, England, gives for repairs alone on the two types of push plate and steel belt hot coke conveyors in use at his works about 3 cents per ton per 100 feet traversed, or in our case about 6.5 cents per ton. When wages, power and interest are added this would become not less than 10 cents per ton. The lower scale of wages and cost of material entering into his repairs as figured above would make this cost still higher in comparison with our figures, so that I think it is fair to assume an average cost for any form of coke conveyor which is in use to-day of perhaps 10 cents per ton of coke conveyed out of the house.

On this basis it would seem that coke conveyors not only paid because of removing one of the meanest and most difficult jobs from our list of hand labor work, freeing to a great extent the retort-house from smoke and steam, and the manager from one more of his vexatious labor items, but also by actually doing the work very considerably cheaper than it can be done by hand.

Milwaukee's conditions for wheeling out coke by hand are particularly bad, and each manager will have to figure for himself what it costs him under his own conditions to do this work.

From our new works we are building an improved type of dry pan conveyor which we think will cut down the cost of maintenance of the old conveyor no less than 30 to 50 per cent., so that instead of 9 cents per ton we expect to do it at the new works for about 6 cents.

GEO. WHYSALL:—This depends somewhat on local conditions. At our plant a saving of 10 cents per net ton can be obtained.

No. 20. What is the specific heat of coal-gas?

V. L. ELBERT:—It depends upon your candle-power. Candle-power ranging from 11 to 18.5, the heat units range from 679 to 887. Specific gravity (air 1,000) ranges from 405 to 530.

ALFRED E. FORSTALL:—Reference: *Journal of Gas Lighting*, Vol. 78, page 1,306.

W. A. BAEHR:—This co-efficient has never been determined experimentally to my knowledge. Besides it would vary immensely with changes of temperature, as any wide range of temperature would certainly cause an immense change in the constitution of the gas. However, assuming the following analysis, we can calculate the specific heat at ordinary temperatures as follows:

	Composition by volume; per cent.	Composition by weight; per cent.	Specific heat; constant pressure.	Product. Specific heat × per cent. by weight.
H	44.0	6.82	3.4090	23.2
CH_4	34.0	42.76	.5929	25.3
N	4.0	8.70	.2438	2.12
Illuminants	8.0	17.08	.4*	6.83
CO	7.0	15.20	.2450	3.72
CO_2	2.0	6.91	.2163	1.49
O	0.6	1.51	.2175	.33
H_2S	0.4	1.02	.2432	.25
	100.0	100.00		63.24

*Assumed.

The specific heat $= \frac{63.24}{100} = 0.6324.$

No. 21. What law will give the specific heat of common gases, such as CO, CO_2, N, H, H_2O, and O, at various temperatures?

"*W. A. Baehr, the Denver Gas and Electric Co., Denver, Colo.:*

"DEAR SIR:—Some time ago I received a note from you asking about the specific heats of gases at high temperatures. I have kept the matter in mind, but have been unable so far to find anything satisfactory that would be of any service in regard to furnace temperatures. The Smithsonian tables give for hydrogen the specific heat over the range $-28°$ to $+9°$ as 3.3996 and for the range $+12°$ to $+198°$ as 3.409; for CO_2 for the range 15° to 100°, 0.2025 and for the range 10° to 214°, 0.2169; for air $-30°$ to $+10°$, 0.237, 0 to $+100°$, 0.2374 and 0 to 200°, 0.2375. From these figures I have always assumed that air and the more "permanent" gases were practically constant in their specific heat after a certain temperature was reached; of course, in the case of compound gases like CO_2, the phenomena of dissociation set in after a certain temperature is reached and then the results vary. In regard to water-vapor the specific heat for the range 128° to 217° is 0.4805. For CO over the range 23° to 99° the specific heat is 0.2425, over the range 26° to 198°, it is 0.2426.

"If I find anything further I will send it. Yours truly,

(Signed.) "N. W. LORD."

W. A. BAEHR:—The above letter relating to question No. 21 was received from Prof. N. W. Lord, Ohio State University, Columbus, Ohio.

EDITOR:—This is a question of considerable importance, especially in gas engine work. Reference is made to this question in Mr. Baehr's report on "Benches," which also gives a graphic table of specific heats of different gases through a range of temperature from zero to 2,500 degrees C. CO_2 has a specific heat, according to this chart, of practically 0.2 at zero, which increases almost in a straight line to 0.427 at 2,500 degrees C. Oxygen has a specific heat of slightly less than 0.2 at zero, and increases in almost a straight line to 0.51 at 2,500 degrees C. CO and N are practically the same, going from practically 0.21 at zero to 0.59 for N and 0.60 for CO at 2,500 degrees C. H_2O is given by this chart as having a specific heat of slightly more than 0.43 at zero, increasing to a specific heat of one point at 2,500 degrees C. This seems to be an unexplored branch of physics that should commend itself to some man of science. An effort will be made during the next year to investigate this subject further.

CARL H. GRAF:—The specific heat of gases does not vary much with the temperature. There is, however, a distinction between the specific heat of gases at constant pressure and the specific heat at constant volume.

No. 22. What is the best calorimeter for solid fuels, and what does it cost?

N. W. LORD:—In my opinion the best calorimeter for solid fuels is the Bomb calorimeter, of which there are several forms. The Mahler bomb manufactured by Golaz in Paris is one of the least expensive and has given most excellent results in my hands. It is lined with porcelain, and will last for a large number of determinations. The platinum-lined bomb used by Professor Atwater in his work on foods is a most admirable instrument, but is much more expensive than the Mahler. I think the Mahler bomb, with all the accessory apparatus, can be bought for about $300 to $350.

The Atwater bomb will cost probably $500, though I do not know the exact figure. I do not think that the forms of calorimeter that burn the fuel at atmospheric pressure are as reliable as the bomb, there being always danger of loss of fuel in unburned

gases. The various forms of calorimeter that use solid chemicals to bring about the combustion while they may give comparative results between different fuels that are valuable, introduce too many unknown factors in the reaction to make their results of absolute value.

B. E. CHOLLAR:—Parr's calorimeter is the best that I know of. The cost complete for liquids and solids, including a small water motor, is $25. It can be obtained from the chemical supply houses.

GEORGE WHYSALL:—Simmance and Abady calorimeter. Cost about $150.

No. 23. What is a satisfactory gas calorimeter to use, and what does it cost?

W. H. BARTHOLD:—Junker calorimeter costs about $200, complete.

R. C. CORNISH:—The Junker's calorimeter for gas is very good, but rather expensive for a small company, costing complete, with meter, thermometers, etc., about $200.

GEORGE WHYSALL:—Junker's gas calorimeter. Cost about $200.

No. 24. What is the best means of enriching coal-gas with oil, and what results can be obtained in candles per gallon?

V. L. ELBERT:—A small oil bench so constructed that it can be heated with pine slabs or any soft wood culls. It is not expensive to build or operate. You will get about 4,500 candle feet per gallon.

EDITOR:—I regret that so few answers were received to this question. A conclusive answer to this question would have a bearing on question No. 2: "What is the proper method of determining the degree of profitableness of each kind of available coal?" It is hard to make exact comparisons where several factors are variables, and it is good practice to equalize all variables where possible, and let the remaining variable be the prime factor. Taking question No. 2 as an example, we may wish to compare two kinds of coal. The quantity and quality of the coke, tar and gas may vary, and the quantity of ammonia may be different. It is an easy matter to reduce difference in quantity to prime factor, *viz.*, cost, but a hard matter to reduce difference in quality to a

basis of cost of value. The value of the coke and tar must be estimated as nearly as possible by the investigator. If one coal yields a gas of 14 candle-power and the other 17 candle-power, it is impossible to place them on the same basis by reducing both to a yield of candle feet. The most accurate method to reduce both to a common basis would probably be to raise the 14-candle gas to 17 candles by enrichment; the cost of this enrichment to be debited to that coal and the increased yield of the oil used to be credited to that coal. Enrichment can be secured in many ways, but in many works it can be more conveniently and cheaply secured by the use of oil in the retorts.

The question cannot be considered as closed, and merits the further attention of this Association.

No. 25. Can tar be advantageously used for enriching water-gas?

V. L. Elbert:—Kansas City used tar for enriching during 1899, and maybe now. Cannot say, however, whether it is advantageous or not.

B. O. Tippy:—A limited amount of water-gas tar can be advantageously used for enriching water-gas, and it is found to be equal in value, gallon for gallon, with gas oil. About 0.5 gallon tar per 1,000 cubic feet gas can be used. The tar is sprayed on top of the coke in the generator. One of the results will be that a much thicker tar will be obtained.

No. 26. What method can be used for enriching gas with tar?

No. 27. Can soft coal, or a mixture of soft coal and coke be advantageously used in a water-gas generator?

V. L. Elbert:—The Rew machine uses soft coal, and they claim where a plant has a capacity of 200,000 feet in 24 hours, it is advantageous.

E. M. Osborn:—No. My experience has been that Pocahontas Smokeless seems to be the best soft coal for use in gas generators. The soft coal used decreases the amount of gas made to such an extent that the coke per 1,000 feet of gas made is equal to or greater than in cases where the soft coal was not used.

It always stops up the checker-work in the carburetor and superheater, rendering the life of the checker-work shorter than when soft coal is not used.

C. E. BURROWS:—No.

W. A. BAEHR:—The writer has used straight lignite coal in a water-gas generator. The generator is first blasted up to heat and then a charge of lignite thrown in, and the coal-gas in it is first driven off, being caught, of course, in the relief holder. When the major portion of the coal-gas is off, steam is turned on. Oil can be used in the carburetor for both gases or for either, depending on candle-power required. Results were very satisfactory both as to cost and as to practical running.

EDITOR:—Soft coal water-gas machines have never proven worthy of general adoption. Soft coal can be used, and so can a mixture of soft coal and coke. We have run our Lowe machines at Denver using coal only as a generator fuel, but we did not find it advantageous to do so. Best results were secured by charging the machine after every blast with just enough fuel to supply the shrinkage of each run and blast. The machine was then allowed to lie idle for a short period, and during this time coal-gas was being generated which passed over to the relief holder. Bad effects from deposit of soot in the carburetor and superheater were overcome by cracking the charging door slightly and allowing some air to pass through the carburetor and superheater while the machines were idle.

During the recent coal strike many of the large companies were compelled to use some coal in their water-gas generators.

No. 28. Would it pay to superheat steam for water-gas making?

J. T. MASON:—I do not think it pays. In my experience with water-gas machines, it has made no material difference in the capacity of the machine. With the superheater on, the clinker will be found somewhat harder in the generator. Last fall when we started up the machines that had been overhauled during the summer and fitted both with superheating rings and steam separators, the maker complained of the hard clinker in the generator, and as there was no complaint from the furnace men in the retort house, I could not believe it was the fuel. I by-passed the superheater and heard no more complaints of hard clinkers. As far as

I could see the machine made just as much gas without it as it did with the superheater.

E. M. OSBORN:—No. My experience in this is to the effect that steam superheated and raised to a temperature of 600 degrees Fahr. would have seemingly no life in it when it passed to the generator.

Have also tried superheated steam, by passing it through an oil heater, and found that the result there was no more satisfactory than when used in the generator, being able to raise the temperature of the oil but a few degrees, and not sufficient to pay for the cost of superheating steam.

C. E. BURROWS:—Yes.

THOS. D. MILLER:—It would depend upon how much it would cost to superheat the steam, as to whether it would pay to superheat it in order to make water-gas.

W. H. BARTHOLD:—At Grand Rapids we superheat the steam for water-gas making by passing it through a cast-iron log in the bottom of the carburetor. The cast-iron log is covered with fire-brick tile so it is maintained at a dull red heat. This superheating of the steam saves fuel and increases the capacity of the apparatus. It prevents cooling of the coke on the grates and thus lengthens the time between cleanings of the fire.

ERNEST F. LLOYD:—If a satisfactory mechanical appliance, cheap in its first construction, not liable to deterioration, heated solely by waste products, can be devised and installed, it would undoubtedly be advisable to superheat the steam for water-gas making; otherwise not. Many attempts have been made but none have come, so far, into satisfactory commercial use.

EDITOR:—It certainly would not pay to superheat steam in the manner steam is superheated for engine use. The efficiency of an independent superheater is seldom above 50 per cent., and the cost of maintenance is considerable. For a fluctuating steam demand the cost of attendance is also excessive. Other than to re-vaporize the water mechanically suspended with the steam, the advantage of superheating would be slight. Assume a water-gas generator supplied with steam at 100 pounds pressure. This steam at the saturation point would have a temperature of 338 degrees Fahr. and would contain 1,157 B. T. U. above 60 degrees Fahr. Were you to superheat this steam at constant pressure to 600 Fahr. you would add but 130 B. T. U., or but 8.35 per cent. to the total heat of the steam. Deadening of the fuel bed at the entrance point of

the steam is primarily due to the presence of an excessive amount of water in the steam. The use of a good steam separator close to the generator will accomplish practically the same purpose as would superheating. Considerable water may be present in the steam and yet not cause any bad effect upon the fuel bed, as in supplying steam from high pressure to low pressure an effect equivalent to superheating occurs and the excess heat is capable of vaporizing a considerable amount of water. A separator is therefore unnecessary, except in long or exposed runs of steam supply piping.

No. 30. How can waste heat from coal benches be most advantageously used?

JAMES M. HADDEN:—I have had considerable experience in utilizing the otherwise waste heat from gas benches. For 12 years I ran horizontal benches making water-gas, the arches and settings of which were very similar to those of coal-gas benches. We used a forced blast and either coke or anthracite coal for fuel in a partly regenerating furnace. Over the top of the vertical flues was a horizontal flue running the entire length of the width of the benches, and parallel with the flue we set a 25-horse-power boiler built of 4-inch tubes. At the stack we had a series of dampers to close the flame from the main flue to the stack and to divert it to the boiler. This flame could be shut off from the boiler in a minute's notice. We ran this boiler for over 10 years and, while having an auxiliary boiler down on the main floor, it was rarely fired. The saving of fuel was great, as we would frequently go months at a time without using a pound of boiler fuel, and this was while running a water-gas plant, using a great amount of steam. We used a Mississippi gage valve which we operated by levers from the floor below.

In looking back upon this arrangement I should say it was complete, and my wonder is that the gas men would allow such a valuable amount of heat, which could be so easily utilized, to go to waste. There is no better absorbent of heat or a better way to store it than by using water.

EDITOR:—This question is too big a problem to be sidetracked by casual consideration. On the average not less than 25 per cent. of all the fuel used in gas benches is wasted in spite of the fact

that bench fuel may represent 50 per cent. of the cost of gas making. The first thing to do is to consider means of stopping this, and if means cannot be found then the waste should be made to do useful work if possible.

Many attempts to utilize this waste have failed because a proper analysis of the problem was not made before attempting to solve it. Here is an immense quantity of heat at rather a low potential. It is more than capable of generating all the steam used in an ordinary gas-works. If applied to steam raising, the boilers must be of excessive area and with gas passages of sufficient conductivity to prevent congestion. One attempt, made a year or two ago by a gas manager (who, by the way, does not believe in conventions) failed because he used a tubular boiler without sufficient area of fire tubes to take care of one-tenth the volume of gas he attempted to pass through them. Another failure, made many years ago, was due to an oversight; proper allowance of heating surface was not made to compensate for the low temperature of the flue gases. The capacity of a square foot of heating surface varies in exact ratio to the difference between the inner and outer surface (neglecting effect of radiant heat from the fire box), hence a larger surface is required to do a given amount of work when the flue gases are used than would be required in boiler practice. I think at least 40 square feet should be allowed per horse-power. We have never applied ourselves very industriously to the problem of how to prevent this waste or to usefully apply it. There may be many better applications than for steam generation, and the importance of this subject deserves the serious consideration of this Association.

No. 31. Can the temperature of the water in gas holder cups be maintained in any better way than by the use of steam?

James M. Hadden :—(See answer to question No. 30.)

F. M. Travis :—Hot water for heating gas holder cups can be used more advantageously than steam. Water should be allowed to overflow on the inner side of the cup and return to the heater through a suction pipe reaching nearly to the bottom of the holder tank. This arrangement allows the use of exhaust steam without back pressure.

No. 32. How long a time must be given to start a new bench?

J. T. Mason:—It all depends upon how much time you have, but to dry one and start a new bench properly I would not try to do it in less than three weeks, two weeks to dry it out ond one week in which to heat up the bench to the proper working temperature. If a bench is forced any more than the above time, the life of the bench will be shortened.

V. L. Elbert:—Slow fire until the brickwork quits steaming. Then increase the heat slowly until the required heat is obtained. Judgment, however, must be used and experience is necessary. Therefore, there is no definite time set.

Freeport Gas Light and Coke Company:—Ten days.

Alfred E. Forstall:—Reference: A. G. L. A. Proceedings, Vol. 18, page 41.

Walton Forstall:—Reference: A. G. L. A. Proceedings, Vol. 15, page 26, and Vol. 18, page 41.

D. R. Russell:—Question 32 is very difficult to answer. Depends entirely on what kind of bench you have built. The question is put in such a way as to be difficult to answer. Is it a question of expediency in starting or is it a question of necessity in getting the bench-making gas? I assume the former. I consider that the best method is to allow the other bench to dry by the atmosphere for a week to 10 days after the front is walled up. The question then presents itself whether this bench is next to a hot bench, in a warm retort house, or in a new house without any heat, also whether it is warm and bright or cold and damp; of course, such conditions make a great difference as to how much the bench will dry out in the time specified, so that the question is not so much the time, as it the condition of the brickwork when the fire is first put in it. After the bench has dried out to some extent from the atmosphere, say for a week or 10 days in warm dry atmosphere or warm retort house, a slow fire should be started and kept going at least two weeks, when it should be raised to the charging point, and this should require another week to accomplish. In other words, I think from the time the brickwork is completed, provided you have good warm dry weather or heated retort house, it should take a month before the bench ought to be charged. You can charge a free fire-bench much sooner than a recuperator bench without danger of damage, and if your bench is full depth, instead of a semi-recuperator, the time allowed

should be still greater. The benches are often fired in a hurry and ruined in this way and the blame laid to the construction, design or materials entering into the installation.

W. B. Tuttle:—This depends on how long the benches have been built before it is necessary to start up, but two weeks will be required.

Fort Madison Gas Light Company:—It is best to take three days to get a bench of new retorts just set heated to the required temperature for carbonizing coal. Bring the heats up gradually.

No. 33. Can gas benches be advantageously fired with coal-gas?

Wm. H. Cooper:—No.

No. 34. What sort of a regenerative furnace is best adapted for the use of coal?

J. T. Mason:—Taking all in consideration, I think the Parker-Russell bench is the best for coal. They are easily fired and clinkered, the nostril holes are easily kept clean, and the best part of them is the recuperators. They are large and built in such a way that they can be very easily and quickly cleaned.

V. L. Elbert:—Large flues and so arranged they can be easily cleaned. The Parker-Russell Mining and Manufacturing Company's benches are well adapted for this purpose.

Geo. G. Ramsdell:—Drake's patent tube regenerator furnace.

K. M. Mitchell:—A furnace provided with slanting feeding channel extending down into the front of furnace so that a rod can penetrate any portion of the furnace from the feeding door or chute. It is necessary when using caking coal for fuel in the furnace that a long bar usually of 1.25-inch gas pipe be used to loosen up the caked mass and toss it back, and also to even up the fuel which shrinks away from the sides of the hot chamber. The front of the furnace should have one or two-step grates and beneath horizontal grate bars of 1.25 inch square iron of suitable length. The ash pit should be provided with water-tight pan. The water supply is brought into furnace and drips on the upper step, then to the second step grate and then to the ash pan beneath. A furnace of this description, whether one-half depth

or full depth, will burn slack, nut or lump coal for fuel; usually the same weight of coal as coke is consumed in furnace, but more supplementary air is required for combustion when coal is used.

No. 35. Are there any gas engines in satisfactory use in gas-works for driving exhausters, and how are they regulated for a fluctuating gas make?

C. O. G. MILLER:—We do not drive any of our exhausters proper by a gas engine, but we are sending out from a holder that has only a small initial pressure about 75,000 feet of gas per hour every evening by means of an old 10 or 12-inch exhauster which is driven by a gas engine of 7.5 horse-power. We endeavor to send the gas out under a pressure about 6 inches. As the engine runs at a fixed speed, when more gas is pumped than is needed we take it back into the holder. It has given us splendid satisfaction and has enabled us to make use of a holder which we could not use unless some other means were provided for giving the pressure necessary.

E. C. JONES:—In reply to your letter of February 28 I take pleasure in sending you an answer to question No. 35, as you requested, and I am free to say that I would have preferred nearly any other question on the list, for while the electric light people are adopting gas engines for running their electric generating machinery, there are few gas-works in the country where gas engines may be found. It is like the old creed, "Don't do as I do, but do as I tell you to."

I regret exceedingly that I shall be unable to attend the meeting of the Ohio Association.

It is a deplorable fact that gas men, wherever they are found, sing the praises of gas engines to their customers, but seldom use them in their works. The writer knows of no instance where a gas engine has been used to drive an exhauster for pumping coal-gas directly from the hydraulic main, but sees no reason why this should not be done by providing any of the many compensating devices to regulate the amount of gas handled while the engine is running at constant speed. The writer has used gas engines for driving exhausters for pumping gas into the city distributing system through independent lines of main and across town between gas holders. This has been successfully done with an engine running at constant speed, the time factor being the only important

one to regulate the amount of gas. Gas engines are successfully operated in this city direct connected to the gas compressors, the engine running at constant speed, while the compressor is furnished with an "unloading device" which automatically regulates the amount of gas compressed. Similar compressors operated by gas engines are regulated by ordinary safety valves for pressure regulation.

GEO. WHYSALL:—Yes, at one time the writer knew of engines being used for the purpose designated. A fluctuation in the manufacture of gas taken care of by a compensator.

No. 36. What is the best means for ventilating a retort-house?

F. M. TRAVIS:—Sturtevant fans run by induction motors.

No. 37. What progress has been made in substitutes for wet station meters?

GEO. WHYSALL:—The development of the proportional meter for manufactured gas.

No. 38. Do proportional meters measure a percentage sufficiently accurate as a basis to calculate entire manufacture, where accounts are demanded showing losses by leakage and condensation?

J. T. MASON:—In the manufacture of coal-gas I think there are none yet. We have had a little experience with the proportional station meter, but it has not as yet proven a success. We had one meter connected tandem with one of our wet station meters in which we had just put a new Hinman drum. I took a 30 days' run out of the two meters with a full capacity of the retort house on them. For the 30 days the proportional meter ran 0.5 of 1 per cent. faster than the drum meter. I then put on half the capacity of the retort house; the result for 15 days was different. The proportional kept falling behind more each day till it was running from 15 to 20 per cent. slow. When put back on the full load again it did not take up. It seemed to have lost its hold.

B. E. CHOLLAR:—I know of no proportional meter on the market at present that I consider sufficiently accurate to meet the requirements of gas companies.

E. M. OSBORN:—No. I have found by experience that proportional meters do not measure percentage sufficiently accurate, and that the per cent. of gain or loss measured by them and compared with ordinary station meter was often as much as 16 per cent., and at times even 20 per cent. There were times when though conditions seemed the same the proportional meter would click off almost the same amount of gas as those of the ordinary type, while again it would spurt out and overrun as much as 20 per cent., then growing lazy again would fall short 15 or 20 per cent. without any apparent reason. This we think a sufficient test to cause us to consider a proportional meter unsuccessful.

JOHN A. BRITTON:—This company has had in operation for a period of 18 months a proportional meter having a capacity of 75,000 feet per hour. During that period there has been no time in which the meter could be relied upon as accurate nor used as a basis to calculate the entire manufacture.

Operated in tandem with an ordinary wet station meter we have found that it will register within a range from 75 per cent. slow to 20 per cent. fast, making it as a rule entirely unreliable. After a series of very careful tests we determined it could be made to register accurately by passing through the meter a regular stated amount per hour, and that amount should be within 10 per cent. of the rate of capacity of the meter. This regularity of use was further supplemented by a careful cleaning of the meter daily and by adjustment of the shunt valve. The diaphragm of the proportional chamber needs frequent treatment also with China nut oil (a preparation which, by the way, is used on the coast entirely in diaphragm work), and a careful draining of the registering meter. There seems to be a tendency on the part of the meter to accumulate, in the proportional chamber in the registering meter and in the shunt valve, large quantities of naphthaline, while no naphthaline can be found either through the works before the meter connections or afterward in street mains service or consumers' meters.

The entire difficulty, in my opinion, with the proportional meter is in the construction of the shunt valve; it is improperly hung and not constructed of the proper material. While I am confident it would be accurate for the measurement of natural gas, I do not believe it would be reliable for the measurement of any artificial gases, although, as stated before, I see no reason why it should not be made so that it could be depended upon.

F. W. Stone:—From my experience with proportional meters I do not believe they measure a percentage of gas sufficiently correct to be used as a basis to calculate the entire manufacture where accounts are demanded showing losses by leakage or condensation.

No. 40. What is the present practice in building new coal-gas purifying houses in regard to the number of boxes; *i. e.*, where it is desired to run without adding air would it not be better to have three instead of two deep boxes, using one as a reserve to turn in when changing the third?

Ernest F. Lloyd:—There should be a balancing limit in purifying plants between capital charge and operating expense, the small number of boxes having naturally the least capital charge implies also the largest cost for operating, and *vice versa.* Oxide which shows foul will generally have a considerable remaining capacity for absorbing sulphur. In a three-box system, if the first box is not changed until the second begins to show foul, it will do a great deal of efficient work. The boxes should be as deep as a single layer of oxide will satisfactorily work, and this would seem to be materially in excess of current practice. In any event the argument for a third box I consider to be very strong.

Henry S. Whipple:—I have used the two-box system of purification for the past two years and my experience with it is not very satisfactory. It is difficult to prevent the foul gas from finding some way through the oxide and showing at the test cock before the oxide is one-third used. When this happens with one box on you are likely to have some dirty gas pass to the consumers' burners. If I had a third box to use when taking off the dirty one I would be saved any trouble from complaints of sulphur in the gas, which has happened twice in the two years. While I may have decreased the cost of purifying by over one-third of a cent. per 1,000 by changing from three box (shallow ones) to two deep ones, yet I purified 2.5 times the quantity of gas per bushel with the three boxes that I have with the two boxes; and in the first case I never had a complaint of dirty gas, while I have in the latter.

No. 41. Is anything being done to prevent naphthaline deposits by adding a definite amount of gas naphtha? How much? Where?

F. M. Travis:—One gallon of 76-degree naphtha to each 10,000 feet of gas, sprayed into the outlet of the holder will aid in preventing naphthaline deposits.

Freeport Gas Light and Coke Company:—We have had perfect success in clearing our mains and services from naphthaline when stoppages occur, by vaporizing two gallons to 25,000 feet of gas sent out, afterward during the period of the naphthaline disturbances with one gallon to 25,000 feet.

W. A. Baehr:—The writer does not use gas naphtha, but uses Pintsch hydrocarbon oil, as we have a Pintsch plant. This oil is vaporized every day and sent through the feeder mains at the hour of maximum consumption. We use 20 gallons per day in Denver, and although we could probably refrain from using it during the spring and summer months and still be safe, I think "an ounce of prevention is worth a pound of cure."

Ernest F. Lloyd:—If naphthaline is in the gas when it passes into the street mains the addition of naphtha or any other hydrocarbon having an affinity for it is only a partial remedy for the reason that so soon as the gas is subjected to a temperature which will condense such added vapors the naphthaline will again be set free rather than be carried down with the vapors, hence the addition of such vapors is only useful so long as the gas is above the temperature at which they would precipitate.

If the naphthaline is produced in the first instance, it can be duly removed by a proper system of condensation supplemented, if necessary, by washing or treating the gas with dead oils in one or more compartments of a standard washer scrubber or other apparatus which would bring the gas into contact with such oils. The term "dead oil" is used to include a tar which has been tested to a point of driving off the naphthaline series.

No. 42. With what degree of success has natural gas been mixed with either coal or water-gas? What percentage of natural gas was used, where was the point of mixture, and what would be the result of too great a percentage of natural gas?

V. L. ELBERT:—If you know the constituents of your natural gas, water-gas can be made from soft coal and oil, mixed in the holder or mains, and it will take an expert chemist to note the difference. The Kentucky Heating Company, Louisville, Ky., have operated such a plant since December, 1893.

E. E. EYSENBACH:—I have mixed natural gas with coal-gas in percentages from 2 to 20. The points of mixture were the hydraulic main, the exhauster, the condensor and the holder. The best results were obtained when mixing in the hydraulic main, but the difference is not large. In all cases, when the percentage increased above 12 the flame in the open tip would become loose and flabby. The light in the incandescent burner, of course, would not be affected; the more natural gas the better for these burners. Water-gas would undoubtedly be able to carry more natural gas than coal-gas, as its large percentage of CO, with its short stiff flame, helps to keep the natural gas flame as it should be.

E. M. OSBORN:—Natural gas has been mixed with water-gas very successfully. As high as 40 per cent. is used, but would recommend 20 or 30 per cent. Point of mixture takes place just above the fire in the generator, and passing up through the hydrogen generated from the application of steam to hot coke in the generator, mixes before it enters, and as it enters the carburetor, there meets the oil sprayed upon the checker-work of the carburetor. We then have hydrogen and the gases from the natural and the oil gas, passing through the checker-work of the superheater, which thoroughly mixes them into a perfect gas. It is unnecessary to state that in the composition of such a gas the marsh gas is increased in proportion to the amount of natural gas used. Too great a proportion of natural gas would result in it being hard to keep up the heat in the carburetor and superheater, and would also have a tendency to decrease the candle-power.

DONALD MCDONALD:—The man who is asking this question is thinking of diluting his coal-gas with natural gas. My only experience lies in diluting natural gas with artificial gas. He will find that the natural gas lowers the candle-power considerably. My trouble comes that the artificial gas decreases the heat units and makes the gas pop back in the mixers.

PAUL DOTY:—Natural gas has been successfully mixed with either coal or water-gas—or both, in that the mixed gas was sold as a "merchantable gas," complying with all candle-power requirements. As high a quantity as 40 per cent. natural gas was mixed

with water-gas with good results. Approximately 25 per cent. was admitted at the top of the carburetor and 15 per cent. at the inlet to the purifiers at the same time. Better candle-power results will be obtained by mixing at the inlet of the carburetor than by mixing at the inlet of the purifiers; the latter practice being only an emergency practice to keep the holders up. Natural gas being so largely methane, it has been found practical to enrich water-gas with much less than the usual quantity of oil. This, probably, is due also to the fact that natural gas has some illuminants in its own composition. Owing to the small amount of oil required to enrich the mixture of water-gas and natural gas, it will be difficult to keep the heats in the carburetor and superheater down if the cold natural gas is not allowed to enter the carburetor. Good practice insists in keeping the carburetor and superheater cool when admitting natural gas.

Natural gas does not mix so readily as coal-gas, but I think that from 10 per cent. to 15 per cent. can be admitted safely, but with more the flame would be soft and flabby.

Too great a percentage of natural gas makes the mixed coal and water-gas soft and flabby when burned in an open flame. The flame flickers badly in a slight draft.

No. 43. How does the cost of purification in the West compare with the cost of 10 years ago?

E. M. Osborn:—It is much cheaper.

C. E. Burrows:—Ten years ago we were using the same material we now use, *viz.*, home-made sponge, and the cost is so small as to be almost a negligable quantity.

Thos. D. Miller:—Cost of purification of gas at Dallas, Tex., is about 0.1 of what it was 10 years ago.

Freeport Gas Light and Coke Company:—Owing to improved facilities, less than half.

Editor:—The cost has diminished considerably; the knowledge of the effect of velocity on purifying results has done more to cheapen the cost than has any other factor. Good scrubbing has also cheapened the cost. A good engineer always considers both fixed and operating costs of everything, aiming to get the lowest total cost. Money is often invested in purifying equipment (ground space, houses, boxes, valves, conveyors, etc.) for

the sake of reducing operating expenses, which is entirely unwarranted. The investment for purifying equipment may be assumed at from $15 to $75 per 1,000 cubic feet capacity per day. A fair average investment charge will be, say, $30. Operating expenses, where oxide is used, will vary from, say, 0.1 to 1 cent per 1,000, and probably 0.25 can be taken as an average in well-regulated plants. We will assume the average gas company must sell its bonds on a 5.5 per cent. interest basis and our depreciation is 2.5 per cent. Then assuming an investment of $30 per 1,000 cubic feet, our fixed charges become 5.5 + 2.5 = 8 per cent. of $30 = $2.40 for 1,000 cubic feet per day, or 365,000 cubic feet per year—a cost of $2.40 ÷ 365 = 0.657 cents per 1,000. It is apparent that this would be the minimum cost for fixed charges, as we have figured on working these boxes at their maximum capacity every day in the year. This would mean that our output for every day in the year would be equal to our maximum day's output. We know that this is not the case, and as our fixed charges *are* fixed, our cost per 1,000 will increase if our output diminishes. The yearly load factor on basis of maximum daily demand would be from 55 to 70 per cent. By this I mean that our yearly output would only be equivalent to approximately 200 days × the maximum days' demand, or approximately 255 days × maximum demand. If we assume a load factor of 65 per cent. (approximately 237 days at maximum days demand) our cost becomes 65 per cent. of 365,000 = 237,000 cubic feet and $2.40 ÷ 237 = 1.0 cents per 1,000 cubic feet purified. If our operating cost is 0.25, our total cost becomes 0.25 + 1.01 = 1.26 cents per 1,000, our operating cost being but 18.25 per cent. of our total cost. From this line of reasoning I conclude (1) that operating costs of purification are already so low as to be of minor importance; (2) that our most rigid attention should be directed towards reducing our investment for a given capacity. As an example, we can afford to increase our operating expenses 100 per cent. if that will permit us to reduce our investment expenses by 25 per cent. This would result in about the same total cost for purification.

No. 44. What is the cause of the cracking and crumbling in a month's time of the three top layers of firebrick in the carburetor of a water-gas machine?

V. L. ELBERT:—Poor material.

E. M. Osborn:—The action of oil on the checker-work of the carburetor has a tendency to soften the brick, together with the action of air during a blast, causing the first rows of brick to crumble in a short time. The bricks lower down in the carburetor of the Lowe machine, or higher up in the carburetor of a Springer, do not receive the effect of the oil to such an extent, hence last longer.

Thos. D. Miller:—The top layers of the checker bricks in the carburetor are cracked and crumbled by the coking of the fixed carbons in the oils.

Ernest F. Lloyd:—Principally improper spraying of the oil as it enters the carburetor.

No. 45. What is your experience in extracting mud from holder tank, with holder in every day service?

C. L. Steenbergen:—I removed the mud of 30 years' creation from a small holder with a basket-shovel fastened on a length of 0.75-inch pipe.

F. W. Stone:—At our works we had mud in the holder pit, caused by water washing down a side hill. We took out what we could by means of a grab bucket swung on the end of 1-inch pipe. After that we stirred up the mud, pumped out the muddy water and replaced with clean.

At another works mud got into our outlet pipe. This we flushed out with water.

No. 46. Do you know of anything better than horse manure, or spent lime to stop holder tank from leaking while in every day use?

F. W. Kelley:—Barley sprouts.

F. M. Travis:—Bran.

V. L. Elbert:—Manure or spent lime are practically worthless. Bran is a better substitute mixed with some kind of a seed that would sprout in water. The better way where cracks are vertical, is to cement the same while tank is full of water.

Thos. D. Miller:—I have found the use of dry sawdust pushed down in some sort of a receptacle released underneath the water in the neighborhood of a supposed leak in the holder tank,

quite effective in checking such leaks. In releasing the sawdust in the neighborhood of the leak the sawdust is caught by the current of the water flowing to the leak and carried into crevice, where it expands.

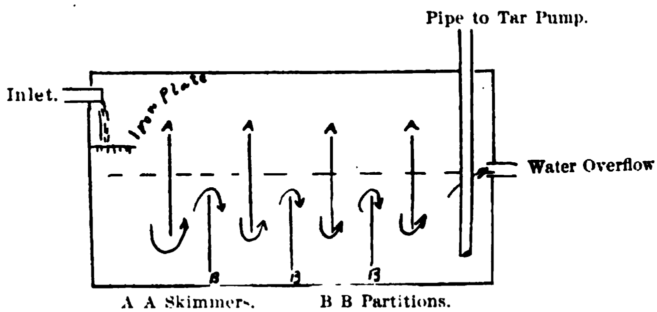
HENRY B. LEACH:—We have one leaky holder tank, and horse manure works the best of anything we have ever tried.

FORT MADISON GAS LIGHT COMPANY:—Should you know the approximate location of the leaks, I think the plan of spreading over the leaky surface sheeting heavily saturated with coal-tar is better than horse manure or spent lime for stopping leaks in the wall of holder tanks. The pressure of the water in the tank forces this prepared cloth close against the side of the walls and shuts off the small leaks in the masonry.

No. 47. What is the best method of disposing of discharge from a wash box or tar well, in a small gas plant, where there are no sewers, and it is forbidden by the people of the town to allow any tar or oily matter to pass off on top of water?

F. M. TRAVIS:—Discharge from the washbox of a water-gas plant can be pumped into relief holder tank, and tar allowed to settle, this tar being used for making steam if desired. Any overflow from this relief-holder tank can be passed through a filter-box filled with coke, this coke being burned when foul. The overflow from a tar well can be made harmless by passing through a coke filter.

J. T. MASON:—To avoid the tar or oily matter from getting out of the plant, I would suggest a separator built as the enclosed sketch (one like it being in use here in the Milwaukee plant). It



TAR SEPARATOR, LONGITUDINAL SECTION.

consists of a large box or well having two sets of partitions built perfectly tight to the sides of the box, the partitions being spaced about 20 inches apart. One series of partitions is set in about 4 or 5 inches from the bottom and reaches to 5 or 6 inches from the surface. The other series is set in about a foot from the surface and reaches to the center of the other set of partitions. The lower set, B B, is to hold the tar and heavy particles back, while the upper set, A A, called the skimmers, holds back the oil that may float on the top. There should be skimmers and partitions enough to clear the water of all oil and tar, so that the water flowing out of the overflow is clean. The box should be built plenty large enough, the larger the better, so that any increase of flow will not affect it.

The water in Milwaukee flows into another compartment or tank, from which it is pumped back through the wash box, so there is very little that finds its way out of the tanks. I would recommend the above being done, as it saves the water and prevents putting cold water in the wash box.

The overflow from the wash box flows into the box at one end, striking an iron plate which spreads the flow in the box; then the water, tar and oil fall together in the separator, the tar going to the bottom and the water flowing zigzag along the box to the overflow at the other end. The tar flows along the bottom to the same end as the overflow, where the suction pipe to the tar pump is set. This suction pipe is put in so that the end is 2 or 3 inches above the lower edge of the lower partitions. It was placed this way so that when the tar is being pumped out it will not break the tar seal at the bottom.

If the small plant cannot use the tar for anything else, I would suggest it being used as fuel under the boilers.

V. L. Elbert:—Put in a good separator and collect the tar in one tank and the water in another. Tar can be used to mix with coal-tar for paint. The water tank should be an open tank in order that the water can cool. It can then be pumped over, through washer or seal pot. The water, being charged with hydrocarbon, will absorb no more and the candle-power should thus be maintained on less oil per 1,000.

C. J. Fox:—Sink two wells to sandy soil, one to be used as a settling cistern, the other as an overflow to take off water. Some will run off through the sand. Use tar for boiler fuel, or sell if profitable.

I. C. Baxter:—Some years ago, when I was engineer of the Detroit works, I put in an apparatus of this kind to catch all the drippings from the Pintsch plant, oil water-gas plant and coal-gas plant. I believe John R. Lynn read a paper on this at one of the meetings. I think you will find sketch of same in the second volume of the proceedings of the Western Association. You will also find one, something similar, but only for a small works for filtering tar, with sketch of same by W. L. Brown, in the proceedings of the Western Gas Association, at the seventeenth annual meeting, 1894, held at Cleveland. These copies, I think, cover the matter fully.

Ernest F. Lloyd:—Dig a hole into the ground and let the waste run into it. In a gravelly soil, I have pursued the above course with very good success. The gravel seems to intercept the oil and a very considerable quantity of waste for a long period can be taken care of in this manner.

No. 48. What is the cheapest method of removing from gas, sulphur compounds other than H_2S?

Ernest F. Lloyd:—Washing in strong ammoniacal liquor is a great assistant in removing sulphur compounds. The English system of purification with four sets of boxes is considered to be the only thoroughly effective method.

Geo. Whysall:—By use of water.

No. 50. What is the better practice—to carry 0.5-inch seal in the hydraulic main and pull even gage, or to carry one-inch seal and pull 0.5-inch vacuum?

Freeport Gas Light and Coke Company:—One-half seal and level gage.

B. H. Petley:—I believe that it is better practice to carry a 0.5-inch seal and pull an even gage rather than carry 1-inch-seal and pull 0.5-inch vacuum, because it lessens the work on the exhauster, thus increasing its capacity; and the liability for the exhauster to "run away," should the dip pipes become unsealed during the time of drawing and charging is avoided.

Geo. MacMillan:—Should pull even gage.

WM. H. COOPER:—It is better to carry 1-inch seal, exhauster to maintain 0.75-inch vacuum on the hydraulic main.

W. B. TUTTLE:—Where tar forms a seal in the hydraulic main it would be better to carry a 0.5-inch seal and pull with even gage. The pressure in retort would be less and the gas would be in contact with the tar for a shorter time and would consequently be a better candle-power. Where ammoniacal liquor is used for a seal in the hydraulic main, I do not think there would be much difference in the result from either method.

No. 51. What would be the effect upon the amount of gas made per square foot of grate per hour, of the maintainance of a level gage on the outlet of a water-gas apparatus during the gas-making period?

B. H. PETLEY:—I do not see how a reduction in pressure at the outlet of a water-gas apparatus to overcome the back pressure caused by the water seal, holder pressure and friction, can have any appreciable effect, other than a slight increase in gas saved due to the retention of a lesser quantity (on account of lower pressure) of gas in the set.

No. 52. How is the amount of superheating surface in a Lowe water-gas set determined, assuming that naphtha is the oil to be used?

GEO. WHYSALL:—By experiment.

No. 53. What boiler horse-power would be required per 1,000,000 cubic feet of gas made per day, for a water-gas plant and for a coal-gas plant, respectively, of 1,000,000, 3,000,000 and 5,000,000 daily capacity?

No. 54. Are there any new developments to successfully prevent naphthaline forming about the works, and what methods are generally used?

FREDERIC EGNER:—I have seen a washer in a German works that was intended to prevent naphthaline formation and said to be O. K. This I recently mentioned in one of our journals (*The*

American), translating a short topic I found in a German paper upon the subject. The machine, like the Mitchell scrubber; and in some of the compartments anthracene is put in instead of water; and that denudes the gas of naphthaline; I have no doubt of that myself, only I would add that in my opinion some of the illuminants go with it. A much better way is not to make naphthaline. Anthracene oil (C_{10} H_{14}) is obtained in the distillation of coal-tar; and comes over as about the last of the heavy oil. As I said, I have no doubt the claims made for its naphthaline removing power are well founded, but add above caution on my own account. *Pure anthracene* is not a liquid, but the first run of it before final working up is; and that is the article used. The same apparatus is also used to remove cyanogen from the gas. Some (the first two) compartments are filled with anthracene oil; the last four or more, if you like, with a coperas (20 per cent.) solution. The first to take out naphthaline, the last to take out cyanogen, which is very destructive to the iron of gas holders. The whole thing is the invention of Dr. Bueb, an assistant (or was) of Herr Wm. V. Oechelhaeuser, General Superintendent of "The German Continental Gas Association," headquarters at Dessau, where I think those of you who wish can address Dr. Bueb, who no doubt would be glad to hear from you.

GEO. WHYSALL:—A steam jet spraying 88 degrees gasoline has been found to successfully remove naphthaline and to some degree has prevented its formation about the works.

No. 55. Would a half-depth furnace, set the same as for heating retorts, be more successful for heating a steam boiler than the usual way of firing?

GEO. MACMILLAN:—I tried a modification once, but it didn't work well.

W. B. TUTTLE:—The difficulty with the half-depth furnace under a steam boiler would be that it maintains practically a constant temperature and it would be very difficult to change the draft from time to time to keep the proper steam pressure up without materially injuring the efficiency of the furnace.

EDITOR:—I have heard this problem asked so often that for this reason I do not want to see it passed over without being answered, although I have not the time to do it justice. To be

brief, I would say that our bench furnaces are not at all applicable to boiler firing and that such a furnace would not be successful or economical. The two classes of work are entirely different. In boiler firing we want an immense quantity of heat at a moderate temperature, while in bench firing we want a small quantity of heat at a high temperature. By use of economizers all heat above 300 degrees Fahr. can be advantageously used in boiler firing, while in bench firing we want a temperature of 2,000 degrees Fahr. or more. A bench furnace works at a constant load and the thermal capacity of the furnace is of little importance. A boiler works over a great range of load and must be constructed to respond to these variations quickly. The introduction of a great mass of furnace brickwork would make the control of the boiler furnace very sluggish. When you were trying to get heat into your boiler, a portion of it would be going into your brickwork owing to the higher temperature of your fire box, and when you would attempt to curtail the supply of heat to your boiler to keep safety valve from blowing, your brickwork would immediately commence to give off to the boiler the excess heat stored in it. In a bench furnace, great capacity is unimportant, and for best results it is doubtful whether we should attempt to burn more than 8 pounds of fuel per square foot of grate per hour. If the furnace was round or even square, we could safely increase this amount to 10 or 12 pounds per hour. With a boiler you must have a furnace designed for great capacity per unit of area. I have burned in the neighborhood of 60 pounds of fuel per square foot of grate area in boiler work with only a good natural draft. If limited to 8 pounds of fuel per hour per square foot of grate area, our boiler plants would be cumbersome and expensive. We have a 7,000-horse power boiler plant in Denver, and on this basis, considering the low value of the coal we use, we would have to have a grate area of 4,000 square feet, equivalent to 40 furnaces, 10 x 10. Authentic boiler results have been obtained where 80 per cent. of the heat of the coal was made to do useful work, and I don't believe the gas bench was ever built that would do anything like that. I can say, however, that a boiler furnace is more inapplicable for bench firing than is a bench furnace to boiler firing. This is due primarily to the higher temperature required in a gas bench.

No. 56. Will the handling of oxide, in or out of the boxes, cause injury to a person's eyes? If so, in what way, and to what extent?

Freeport Gas Light and Coke Company:—No.

Geo. MacMillan:—If oxide became strongly impregnated with ammonia gas, it would be.

No. 57. Does the handling of oxide affect a person's health any more than the handling of lime for purifying purposes?

Freeport Gas Light and Coke Company:—No.

Geo. MacMillan:—Should think not. Have had one handling oxide 20 years without apparent injury.

No. 58. Has anybody had any experience in extracting sulphur from gas made from coal containing 6 per cent. of sulphur, using three or more washers and iron oxide to perform the work?

B. E. Chollar:—I know of no one who has had experience in extracting sulphur from gas made from coal containing 6 per cent. of that substance using three or more washers and iron oxide. The only way I have myself been able to handle gas from such has been to use lime and change purifiers, not by chemical test, but by meter indications.

K. M. Mitchell:—It cannot be done. I have tried it.

No. 59. What maximum vacuum may be carried safely on a hydraulic main where dip pipes are sealed 0.75-inch before candle-power will be affected? (With clear pipes and 0.75-inch vacuum, pressure on retort is 1 and 0.5-inch.)

Geo. MacMillan:—Don't like the vacuum idea in any form.

No. 60. At what temperature should purifying boxes be kept in order to get the best and most work out of them?

Freeport Gas Light and Coke Company:—From 60 degrees to 70 degrees Fahr.

Geo. MacMillan:—The higher the better chemical action up to about 100.

No. 61. What is the cause of formation of iron carbonyl in water-gas systems? How can it be prevented? Why does it occur periodically in cold weather under seemingly same conditions as when none is formed?

Carl H. Graf:—Iron carbonyl, formed by gas coming into contact with iron, is usually found where new mains have been laid or when new oxide is used. In the former case time will remedy the evil; in the latter good results have been obtained by putting the new oxide in the first or foul box and allowing the old oxide in the following boxes to remove whatever carbonyl is formed.

No. 62. What remedy can you suggest for the steam nuisance when coke is quenched below iron floor of retort house?

Irvin Butterworth:—The nuisance can be mitigated by putting in large galvanized-iron open pipes running from the ceiling of the retort cellar up through the retort house near the walls, where they will be out of the way, and terminating above the retort-house roof. Or the nuisance can be prevented altogether by conveying the hot coke, before it is quenched, outside the retort-house cellar, using one of the several forms of conveyors that are now on the market for this purpose.

B. H. Petley:—Relief from the steam nuisance in the retort-house cellar may be obtained by erecting a wooden box passageway overhead on a line with the position of coke barrows at time of drawing charges, with openings at each chute provided with slides or doors for closing when not in use; passageway to be connected with an exhauster located in a closed room in one end of the cellar; discharge to be carried outside of building.

Geo. MacMillan:—A strong exhaust fan.

No. 63. What is the relation between the candle-power and the specific gravity of carbureted water-gas?

No. 64. Would a separator similar to a cream separator, such as is used by dairies, do to separate water from tar, more especially oil-tar produced from carbureted water-gas?

J. D. SHATTUCK:—Chas. Cattell, Superintendent of the Westchester Gas Company, is using a cream separator for separating water and tar made from carbureted water-gas and claims it is very successful.

CARL H. GRAF:—Almost any separator that will allow the tar to settle to the bottom will work, provided the proper temperature is maintained.

EDITOR:—Such a separator is already in use in England and is handled in this country by Geo. Shepherd Page's Sons. I do not know how effective it is.

E. E. MORRELL:—In 1895 I saw an item in the *Journal of Gas Lighting* regarding a tar separator that was being used in England, and which was manufactured in Copenhagen by H. C. Petersen & Co. The question of separating water from water-gas tar was a very important one with us at that time, owing to the fact that we could not dispose of our tar directly from our well. After reading the article in question, I called upon several manufacturers of cream separators and at last found a second-hand separator with a 24-inch bowl which had been made in Denmark and similar to Petersen's, and which was of no value as a cream separator at that time.

I secured this separator very cheaply and made a number of experiments with it after altering the separating nozzles. The separator worked fairly well when the tar was thin and free from lampblack or other particles of fixed carbon carried over from the wash boxes, as would be the case with water-gas-tar. I found, however, that it cost too much for labor to operate this apparatus. I do not think there would be any question of this apparatus separating the water from coal-gas tar satisfactorily, but I do not believe it would be at all economical to use on water-gas tar. After deciding fully that the separator could not be used to advantage on account of the attention necessary to run it, I built a still which was a complete success in every way and we had no trouble in handling and disposing of the tar thereafter.

No. 65. What is the true or correct water-line for station meter? Some engineers claim this line should be adjusted to the average working pressure. Others claim that the level should be gotten when the gas pressure is off the meter; that is ,after the meter is tested in the usual way, adjust the overflow to the water

level of the front gage and then put the meter in use. As opinions are so numerous on this point, it seems that some standard should be established, if such has not already been done.

B. H. PETLEY:—I believe that the correct water line for a station meter should be that of the measuring chamber or interior of the drum, consequently that the overflow should be set and governed by the meter inlet pressure.

No. 66. We know that steaming naphthaline out of pipes is bad, but what other way is there to clear out an obstruction after gasoline has failed to take effect?

WM. H. COOPER:—Use hot water.

CARL H. GRAF:—If there is any opening through the main, an effective way is to distil naphtha by means of steam or hot water and allow the vapor to travel along with the gas.

W. H. BARTHOLD:—Would suggest in steaming naphthaline out of pipes that naphtha be used at the same time, then the steaming will not do harm, as indicated in the question.

GEO. WHYSALL:—By the use of steam and gasoline in combination.

B. H. PETLEY:—I have found flushing with hot water to be most successful in the removal of naphthaline from washers and scrubbers, and the heating of water in the condenser for its removal from that apparatus. I believe naphtha or benzine to be more effective and cheaper than gasoline used for this purpose. In case the use of oil proves ineffective in removing naphthaline from pipes, I believe they had better be taken down and thoroughly cleaned with live steam.

No. 67. What weight of ammonia in grams per 1,000 cubic feet would be allowable at outlet to purifier in fairly good practice?

FREDÉRIC EGNER:—It seems to me it would be very poor practice to allow any ammonia in pure gas or lets say "finished" gas.

W. B. CALKINS:—In London, where conditions are such that the laws regulating the purity of gas are more stringent than would be necessary in lighter and less compact cities, the maximum amount of ammonia in each 100 cubic feet of gas is placed

at 4 grains, or about 2.66 + grams per 1,000 cubic feet. In order to bring about these conditions, the scrubbing and cooling of the gas must be carefully regulated. But in fairly good practice, I think that 6 grams of ammonia per 1,000 cubic feet of purified gas would be allowable. The nitric acid formed from burning 1,000 cubic feet of gas containing this amount of ammonia would not vitiate the air in a common-sized room if proper ventilation were observed.

GEO. WHYSALL:—About one gram.

No. 68. Are there any practical methods by which gas can be made so free from ammonia that it cannot be detected by "Nessler Reagent" or some other sensitive test?

W. B. CALKINS:—I know of no practical method by which gas can be made so free from ammonia that it cannot be detected by "Nessler's Reagent." "Nessler's Reagent" test is so delicate that it will show the very smallest traces of ammonia in distilled water.

GEO. WHYSALL:—By thoroughly washing and scrubbing.

No. 69. What states have laws in regard to ammonia allowed in gas and what is the limit in the different states?

No. 70. What are the results of your experiments with machine cuttings from coal mines?

No. 71. What would be the advantage or disadvantage of running a 150-kw. generator with a gas engine in a combination plant where the maximum output of the gas plant is 50,000 cubic feet per day

EDITOR:—The advantage or disadvantage of running a 150-kw. generator with a gas engine would depend entirely upon local conditions which would affect the total cost. A gas engine costs more per horse-power than a steam engine, and this is especially true when both are rated on their maximum capacity. A gas engine, as a rule, is rated upon its maximum capacity, while a steam engine is rated upon its most economical capacity. With a higher cost for a gas engine the saving must be considerable to compensate for the increased fixed charges if the output

of the engine is a small amount. Another disadvantage of the gas engine is its low efficiency at light loads. On the engines suitable for running generators the friction amounts to about 25 per cent. of the rated capacity of the engine. Therefore a gas engine station should be fitted up with a number of units of different sizes, which would enable them to be operated at practically their rated load when operated at all.

No. 72. What are the advantages of the so-called "high efficiency" scrubbers, such as the evolving brush scrubber made in England?

EDITOR:—I fail to see any great advantage in the so-called "high efficiency" scrubbers. Good distribution in tower scrubbers makes them very efficient with a small expenditure of power and a low investment cost. Assuming a yield of ammonia of 5 pounds per ton of coal carbonized, and assuming a yield of 150 pounds of water per ton of coal carbonized, the maximum average strength the liquor could have would be 3.33 per cent., corresponding to about 12 ounces liquor. The yield of water generally exceeds 150 pounds per ton of coal carbonized, and the yield of ammonia is generally less than 5 pounds. If the gas is thoroughly scrubbed with ammoniacal liquor by repumping, it can be brought to 10 ounces strength under favorable conditions. The excess ammonia must be taken up with clean water. I see no object in working some of the ammonia up to 60 ounces strength while the balance of it is allowed to remain with a strength of about 4 ounces. The average strength is not much greater than it would be without a high-efficiency scrubber. The use of such a scrubber will allow the use of a lesser amount of clear water, permitting a slight saving in the quantity of steam required to distil off the ammonia and also permitting the use of a slightly less amount of fresh water, which would in theory indicate a higher candle-power for the gas, but with effective tower scrubbing the use of fresh water is already so small that an increase of 100 per cent. would not make a noticeable difference in the candle-power of the gas.

B. H. PETLEY:—The advantages of the so-called "high efficiency" scrubbers, such as the brush, are that the crude gas containing ammonia is brought very intimately in contact with the water, and as comparatively very little water is thus required, a strong crude liquor is obtained for treatment in an ammonia concentrator.

No. 73. Why do some gas engineers place the first scrubber between the tar extractor and the condenser, instead of placing the condenser between the tar extractor and the scrubber, as is the usual practice?

GEO. WHYSALL:—To reduce the temperature of the gas.

No. 74. Is the Claus process of gas purification in satisfactory operation at any works in this country or abroad?

FREDERIC EGNER:—Permit me to chip in here, too, by saying, "I think not." Let me add to this, that figuring it closely long ago, I found it would not pay, even in a pretty large works.

CARL H. GRAF:—Some years ago the Claus process was in use in the Belfast, Ireland Gas-Works, but do not know that it is now in use.

No. 101. Does it pay to lay services in a wooden trough filled with pitch to protect them from rust and electrolytic action?

MASTIN SIMPSON:—I do not believe it does pay. If we could get the work done as we would do it ourselves, it would be one proposition, but with the inefficiency and carelessness of employes some point is left assailable and hence the value of the whole work undone. In answering this and subsequent questions I am not figuring on theoretical questions, but as such questions are presented to us in our every day operations.

PEORIA GAS AND ELECTREC COMPANY:—It seems to us that in certain kinds of soil the extra expense of laying pipes in a wooden trough filled with pitch would be a very profitable investment, as such precaution would prolong the life of the service indefinitely. In soils like clay or clean sand we think that this precaution would be a useless expense.

For protection against electrolysis, pitch-filled troughs would protect the services, but it would also increase the damage done to the mains and unprotected services.

GEO. KIRK:—It does not pay. In extreme cases, to protect pipe from electrolytic action, connect pipe to rail with copper wire.

THOMAS D. MILLER:—If the electrolytic action is bad, or the soil is particularly destructive to wrought-iron pipes, I think it is best to incase the service pipes in a wooden box and surround it with cement and sand or pitch and sand.

JOHN FRANKLIN:—Consider it too expensive unless service pipe passes through a fill of ashes.

C. J. FOX:—No; use cement.

W. H. BARTHOLD:—We believe it does pay, as it renders the service practically everlasting, and holds the pipe in position and thus avoids sags.

H. D. WALBRIDGE:—Feel quite positive it pays to properly lay service pipes in V-shaped wooden troughs filled with tar concrete. Have never used pitch filler. The tar-concrete method has proven an almost unfailing protection against oxidation, particularly in light porous soils; further, the trough is of advantage in preserving the alignment of pipes, and I believe the method is a material protection against frost and naphthaline troubles, as a service pipe properly laid is thus covered from the street main in and through the outside wall of the building.

I question if the method effectively protects the service pipe from electrolysis. Mr. F. G. Field, an electrical engineer, made some extensive experiments as to the protection this covering afforded service pipes. His conclusion was that a pipe would be less affected by electrolytic action when encased in a wooden trough properly filled with tar concrete, than when unprotected and exposed to action of acids and alkalis percolating through the earth. This is for the apparent reason that the pipe, being surrounded by the tar concrete, which is impervious to water, was kept dry and clean. There was no evidence that the trough and tar concrete were not otherwise as good conductors of the electric current as the earth.

In Grand Rapids, in about 1899, I began experimenting with this method of laying service pipes. Later on we adopted it as general practice, which is still in force. We had but little trouble there from electrolysis. This is believed to be largely due, however, to the street railway company providing ample and proper conductors for their return current, and our belief is supported by the fact that a great many uncovered service pipes installed previous to 1899 are apparently as free from electrolytic action as are the covered pipes.

No. 102. What troubles have gas companies had by gas leaks softening asphalt?

MASTIN SIMPSON:—For six months time we hung in a jet of impinging gas a piece of asphalt, and as far as strength or texture, we could find no difference after the test. I have found considerable softening of asphalt over ditches, but I could never trace them to the gas itself, although there were frequently leaks under such abrasions, but I have found exactly the same conditions over sewer trenches and water mains, and my belief is that it is due entirely to the working of the ground under heavy traffic directly over the ditches.

W. A. BAEHR:—The writer has had some experience with this trouble. Where there were gas leaks in the mains, caused mostly by proximity to the steam heating pipes, the concrete under the asphalt became saturated with gas, getting to be a bluish color. The asphalt itself disintegrated slowly under the same influence and became soft and smelled strongly of gas. The evidence was unmistakeable.

JOHN FRANKLIN:—We have experienced no trouble in this line.

No. 103. Does it pay to use galvanized service pipes?

PEORIA GAS AND ELECTRIC COMPANY:—No. Nearly all the agencies which bring about the destruction of iron in the ground will also attack the zinc-coating of galvanized pipe.

THOMAS D. MILLER:—It not only does not pay to lay galvanized service pipes, but is positively objectionable.

FREEPORT GAS LIGHT AND COKE COMPANY:—Soil in which pipe is laid should determine.

JOHN FRANKLIN:—Have never had occasion to use galvanized pipe, but consider that black wrought-iron, well covered with a solution of General Hickenlooper's prepared tar, equal to the best and more economical.

C. J. FOX:—No; as a rule, defective pipe and fittings are galvanized. More expensive.

No. 104. Is the present Connelly governor sufficient for our needs, or is something more efficient demanded?

PEORIA GAS AND ELECTRIC COMPANY:—If the Connelly governor is not sufficient for our needs, our main systems need attention.

Geo. Kirk:—The Connelly is sufficient for *our* needs.

John Franklin:—I consider none more efficient when properly adjusted and carefully maintained.

Carl H. Graf:—The Connelly governor is good, but does not fill all conditions. The abrupt changes of the automatic governor are noticeable on burners, particularly of the incandescent mantle type, and we have received numerous complaints on this score.

No. 105. How can two automatic governors, at two different stations, be made to operate satisfactorily in relation to each other?

John Franklin:—That depends entirely upon conditions. Two governors can be placed and adjusted to respond separately to feed the same system of mains arranged to open at different pressures, one doing active service before the other opens up.

Geo. G. Ramsdell:—By placing Balance governors ahead of the Automatic governors.

No. 106. What is the minimum pressure which should be maintained at consumers' meters?

J. H. Enright:—We try to maintain a minimum pressure of 2 inches at consumers' meters, and shall endeavor to raise it to 2.5, as I have no doubt of the sale of a large percentage of gas being lost in the efforts of some to hold down their leakage account by manipulating their holder pressure. It is far better to keep your leakage in proper bounds, carry a fair pressure, and thereby not only do away with many troublesome complaints, but you will sell more gas and be surprised to find most of your consumers far better satisfied.

B. W. Perkins:—Two inches.

Geo. Kirk:—Minimum pressure should not be less than 2 inches.

Freeport Gas Light and Coke Company:—Two inches.

Walton Forstall:—Fifteen-tenths is probably the least pressure at the inlet of the consumers' meter that will afford a satisfactory light at the burner, and especially where there are many cooking appliances it would be better to have 20-tenths.

John Franklin:—I am a firm believer in high-pressure system.

THOS. D. MILLER:—Not less than 16-tenths.

C. J. FOX:—Eighteenth-tenths' pressure.

F. W. BLOWERS:—We should say that 20-tenths' pressure is the minimum that should be maintained at the consumers' meter.

No. 107. What are proper instructions to give regarding investigating complaints of poor pressure?

J. H. ENRIGHT:—Test pressure on main in troublesome district, and if found inefficient, remedy by laying a larger main or strengthen it by connecting with mains on streets running parallel to same. Should pressure on main prove efficient, then see that service is clear and of proper size. Should trouble still exist, blow out the house-piping and see that the burners and chandeliers are clear and in good shape, and your trouble will disappear.

B. W. PERKINS:—Try the pressure on adjacent services. If they show right, remove the obstruction from the stopped service or set a new meter, etc.

E. M. OSBORN:—We instruct our assistants to investigate the premises to see whether the low pressure is due to water in mains or to other stoppages, or whether it is caused by lack of supply on account of small mains or some such cause. We use a simple U-gage for pressure testing.

PEORIA GAS AND ELECTRIC COMPANY:—Instructions for investigating complaints of poor pressure: *First,* attach a U-gage to the service, note reading of pressure. *Second,* turn gas on apparatus connected and note reading of pressure. If there is but a small difference between first and second readings, say 1-tenth, the service is O. K. *Third,* attach gage to outlet of meter and note difference between readings when no gas is being used and when all apparatus is in use. As long as the pressure is steady with all the apparatus using gas "full on," a drop of two or three-tenths is permissible. This test shows up any trouble in meter. *Fourth,* attach gage to each piece of apparatus and note difference between readings when no gas is being used and when gas is turned full on apparatus. This test shows up any defects in the piping. *Fifth,* if no trouble is found and complaint of poor pressure continue, attach recording pressure gage to service for one week.

To locate trouble in a district from which a number of poor-gas complaints come, send out a number of men during the hour of the heaviest send-out to take pressure-readings from U-gages attached to the service pipes, or set recording pressures gages at various points in the district affected and note difference of pressure at hour of heaviest send-out. These differences are a good guide to determine the location of the trouble.

GEO. KIRK:—The proper instructions would be to test the pressure with gage on each side of the meter to locate the difficulty.

FREEPORT GAS LIGHT AND COKE COMPANY:—First examine pressure at inlet to meter; if all right there, outlet of meter; then continue to examine pressure at the several openings along line of piping until obstruction is located.

JOHN FRANKLIN:—Give instructions to examine carefully for local trouble, that is, obstructive service, meter or house line. If found clear, have pressure taken along lines leading to main feeders; follow this up until a drop in pressure is shown, which is easily remedied.

C. J. FOX:—Instruct fitter or complaint man the amount of pressure carried in street mains in neighborhood of complaint. He will then proceed to the house of the consumer who made the complaint, and make himself known to the consumer, and then proceed to the cellar, place siphon-pressure gage on end of service, and note pressure. He will then light two or three burners on the fixtures, leave same burning, and go to the cellar and note pressure again. If pressure does not vary, he goes back upstairs again, turns off lights, goes back to cellar, takes off U-gage, plugs service tee. He then places gage on house side of and close to meter, notes pressure and then goes upstairs, lights two or three burners, proceeds to cellar and notes pressure again. If pressure corresponds with pressure on outside of meter, he knows then the meter is O. K. He then places gage on fixture close to house riser. If after lighting two or three burners, the pressure remains the same as at meter, he then proceeds to test from fixtures in different rooms until he finds the trouble and repairs same. He then places gage on fixture, lights all burners and notes pressure. He then invites consumer to inspect lights in the different rooms and makes sure the consumer is satisfied before leaving.

No. 108. What is the best form of portable recording pressure gage?

Peoria Gas Light and Coke Company:—The Bristol Recording Pressure Gage, made by the Bristol Company, Waterbury, Conn., is the best portable gage.

W. A. Baehr:—The Thorpe Portable Recording Pressure Gage, procurable from T. G. Marsh, Examiner Buildings, Manchester, England.

Thos. D. Miller:—The Bristol Recording Pressure Gage, mounted in a suitable box, is the best form of portable pressure gage.

Walton Forstall:—The Bristol Recording Pressure Gage has given us very satisfactory service.

John Franklin:—Center tube or siphon gage.

C. J. Fox:—The Bristol gage.

No. 109. Does anyone use an automatic siphon for siphoning into sewers street main drips that require frequent pumping, and if not, why should this not be safely and economically done?

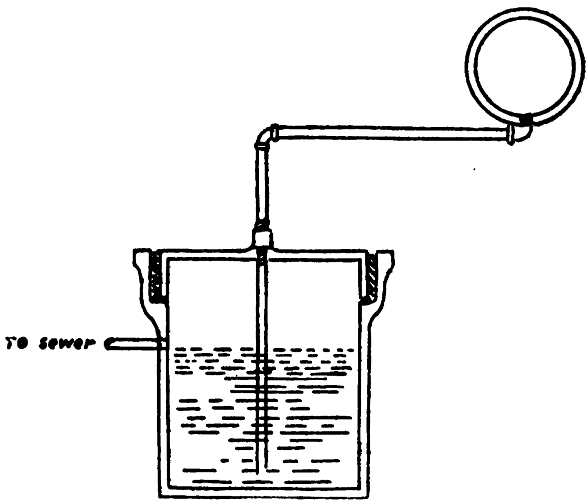
Irvin Butterworth:—In Columbus, O., I put in several siphons of this character. They worked all right, and so far as I know they are still doing so. I see no reason why they cannot be employed with safety and economy in the case of drips that require frequent pumping, although it might be a wise precaution to examine the drips once a year to see that they contain water.

G. N. Clapp:—We have used an automatic siphon for siphoning drip to sewer for about eight years successfully, and during that period we have not pumped it once. The stretch of main drained is laid in wet clay ground. The danger we feared was that the water would evaporate during a drought and would get too low to seal off the gas, letting it escape to the sewer.

V. L. Elbert:—It has been done. It is, however, dangerous.

Peoria Gas and Electric Company:—An automatic siphon would be a good thing to use in connection with a drip requiring frequent pumping, if you could be certain of always having sufficient water to seal it. It is much safer to locate the point where the water enters the mains, and make them tight at this point, because an automatic drip once installed will be left without attention for a long period of time, and there is always a possibility of the

flow of water being stopped and the siphon becoming dry, in which event the sewers would be filled with gas and the company would suffer not only the loss of the gas, but it would also be liable for any damage which might arise from the escape of gas into the sewers. Of course, the siphon drip might be provided with some mechanical contrivance, say a float and valve, to prevent the loss of gas should the siphon become dry, but in this event you come back to the necessity for regular inspection to keep the apparatus in condition to do its work; and as long as the necessity for regular inspection exists the plain drip of large capacity is the best thing for the purpose of keeping the mains clear of condensation, etc.



B. W. PERKINS — SECTION OF AUTOMATIC DRIP.

Thos. D. Miller:—Automatic siphoning into sewerage carries with it the danger of stopping of the sewer and backing of the water, filling of the gas main.

F. W. Stone:—In our place we have about a mile of 8-inch cast-iron pipe laid in wet, swampy ground, full of quicksand. The line has a gradual descent almost its whole length, and then suddenly turns up a hill. The line leaked and the drip had to be pumped every other day at least. I siphoned the dip over a bank, arranged the end so that it could not be tampered with and would

not freeze, and have no trouble. Would be afraid to run it into an ordinary sewer. The sewer might fill up and flood the main.

JOHN FRANKLIN:—Not to my knowledge.

C. J. FOX:—Not to my knowledge. Use steam trap.

No. 110. What is the minimum grade permissible in mains and services?

MASTIN SIMPSON:—In this connection I would say that in city work I have laid 24-inch pipe, using engineer's level with grades of 0.25 to 0.125 of an inch a length. Great care had to be taken in selecting pipe that was not sprung.

PEORIA GAS AND ELECTRIC COMPANY:—The minimum grade permissible in laying mains and services is just the amount required to keep them free from condensation and any water which may chance to enter them. Frequent drips are an evil to be avoided, provided too much expense is not incurred in giving the pipes the grade required to drain them. In long stretches of main, in which the direction of the grades is opposite to the flow of gas through it, more grade is required than when the grade and the flow of gas are in the same direction. Under the latter conditions it is permissible at times to run the mains at a dead level for short distances.

GEO. KIRK:—Minimum grade 1 inch to 50 feet.

W. A. BAEHR:—For mains, 6 inches per 100 feet; for services 8 inches per 100 feet.

THOS. D. MILLER:—Where pipe is carefully laid on a sound foundation a grade of even less than 1 inch to the 100 feet will be perfectly safe, but under ordinary conditions 1 inch to the 100 feet is about as low as should be indulged in.

FREEPORT GAS LIGHT AND COKE COMPANY:—Much depends upon the soil and size of pipe; with good hard clay half of 1 degree is permissible.

JOHN FRANKLIN:—One foot in 100 feet.

C. J. FOX:—One-half inch in 12 feet.

No. 111. What is the advisability and necessity of devising and installing some sort of a maximum demand meter which will indicate and record the rate of send-out each minute of the day?

PEORIA GAS AND ELECTRIC COMPANY:—So far as the gas business is concerned there is no necessity for a maximum demand meter.

GEO. KIRK:—Not necessary.

THOS. D. MILLER:—Maximum demand meters are more in demand for electric light companies. Personally I am satisfied to let the electric light man work this out first.

FREEPORT GAS LIGHT AND COKE COMPANY:—Very important. As a substitute we read our station meter once in two hours and note the amount of gas in holders at same time; in this way we can determine send-out during any two hours.

WALTON FORSTALL:—If the maximum amount sent out by the works is what is desired, this can can be obtained in a very satisfactory manner by taking a record of holder readings at frequent intervals on the afternoons of the days of the greatest consumption.

EDITOR:—There seems to be some misapprehension regarding this question. I think what the questioner had in mind was a recording output meter similar to the recording ampere meters which are used in electric stations. By the use of such a demand meter the load curve could be obtained for every day in the year and every minute in the day. We are interested in knowing what our greatest instantaneous demand is, and this cannot be accurately determined by computing the send-out for every two-hour period or for every one-hour period, or for every half-hour period. Of course, the smaller the interval of time, the closer will be the accuracy of our computation. Such a meter would give us without loss of time what corresponds to the load chart of an electric station, and a well-operated electric station could hardly direct its engineering work properly without the use of such a chart. I am inclined to think that gas managers would find it almost as valuable as do electric managers. The value of this knowledge would only be appreciated after constant use. The question of providing for peaks in an electric plant is of more importance than in a gas plant, but it is of sufficient importance in a gas plant to make its study worth while. The cultivation of a certain class of business will affect our load chart, and naturally we want to know whether it is having a good or a bad effect upon our load. The more closely we approach a uniform rate of send-out the less will be our cost to supply gas, as our fixed cost per 1,000 cubic feet will therefore be diminished, even though our operating costs stay the same. Some interesting data regarding this matter will be found under question No. 112.

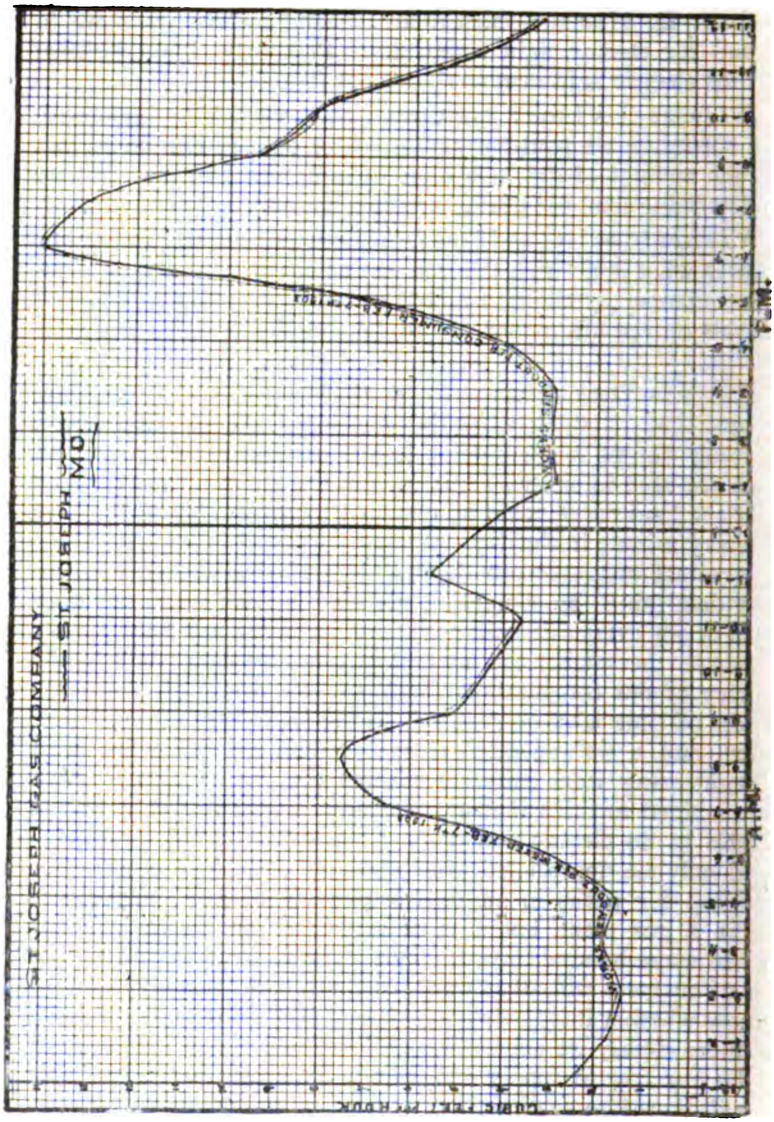


FIG. 1.—MAXIMUM SEND-OUT, FEBRUARY 7, 1903.—ST. JOSEPH GAS COMPANY.

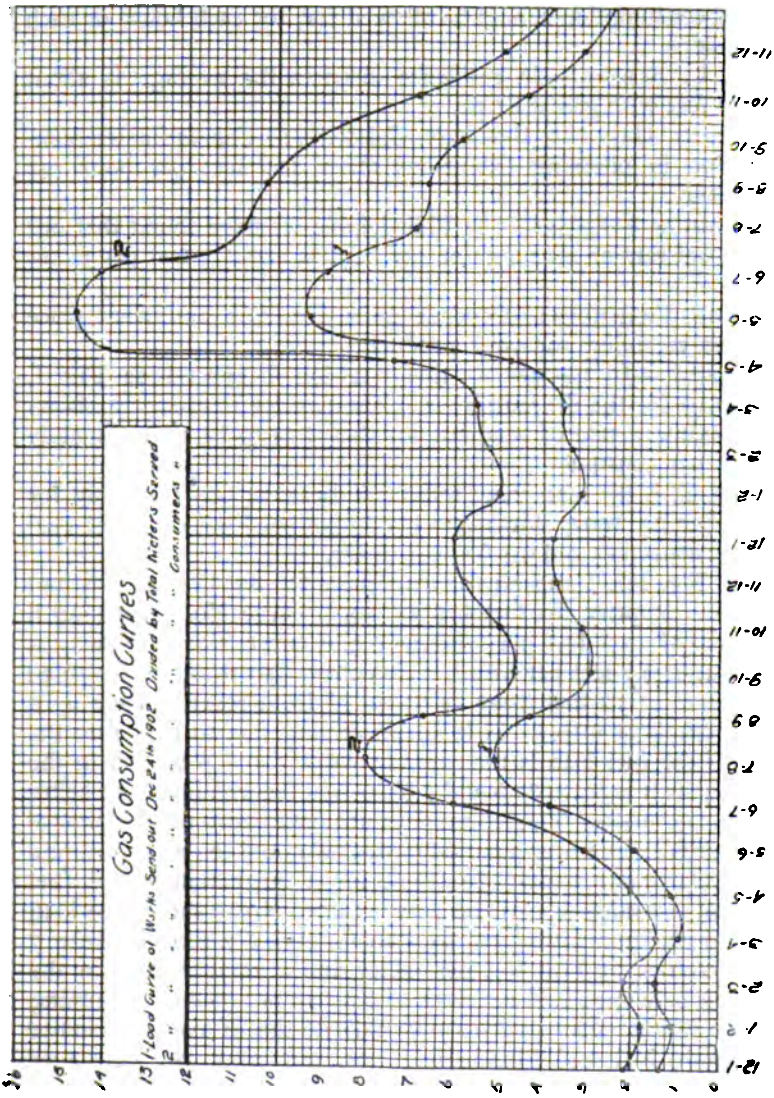


FIG. 11.—MAXIMUM SEND-OUT, DECEMBER 24, 1902.—MILWAUKEE GAS LIGHT COMPANY.

No. 112. In planning extensions to a distributing system, what rate of consumption should be allowed for, for each house or each consumer?

V. L. ELBERT:—In residence districts the average is about 17,000 feet with gas at $1.50.

PEORIA GAS AND ELECTRIC COMPANY:—For estimated consumption in planning extensions allow 100 feet per hour per consumer.

WALTON FORSTALL:—In Philadelphia we have found that our maximum rate of consumption per hour is about 3 feet per meter light.

JOHN FRANKLIN:—Depends upon condition and what price you are receiving for your product.

EDITOR:—In answer to this question I append as Fig I, load chart for the St. Joseph Gas Company for February 7, showing maximum rate of send-out for that date to be approximately 14 feet per consumer.

Fig. II is the load chart for the Milwaukee Gas Company for December 24, 1902, showing a maximum send-out of about 14.6 feet for consumer and 9.4 feet per meter.

As Fig. III, I append the load chart for the Denver Gas and Electric Company for October 22, 1902, curve No. 2 showing a send-out of 13.2 feet per consumer and curve No. 1 showing a send-out of 9.7 feet per meter. This chart also shows the average load curve of 70 fuel users as compiled from records made by a glass complaint meter. It is an interesting fact to note that the peak of the fuel load is the same between 7 and 8 o'clock in the morning as it is between 6 and 7 o'clock in the evening, both being 9.2 feet per meter. This curve does not mean very much, because the records extend over a period of one year, and to get an accurate record the curve should be taken for a large number of fuel users on the same day of the year. Curve No. 4 shows the load chart of 68 illuminating gas consumers, giving a peak between 7 and 8 o'clock of 11.2 feet per meter and a smaller peak in the morning between 7 and 8 o'clock of 6.4 feet per meter. Summing the two simultaneous peaks would indicate that if every consumer used both fuel and illuminating gas, our peak per consumer would be 19.2 cubic feet. The characteristic of the load curve of this town is very different from the load curve in Madison, Wis. In the latter city we get a very heavy peak between 12 and 1 o'clock, while in Denver between those hours we get a very pronounced ravine. I explain this on the theory that Madison, being

a small town, almost everybody goes home to lunch, while in Denver very few people go home to lunch, and therefore many of the domestic stoves are not used at all at noon and between these hours practically no industrial fuel gas is used.

To sum up, I would assume from my present available information that in figuring the maximum demand for ordinary domestic consumers it should be 100 feet for one consumer. Where two

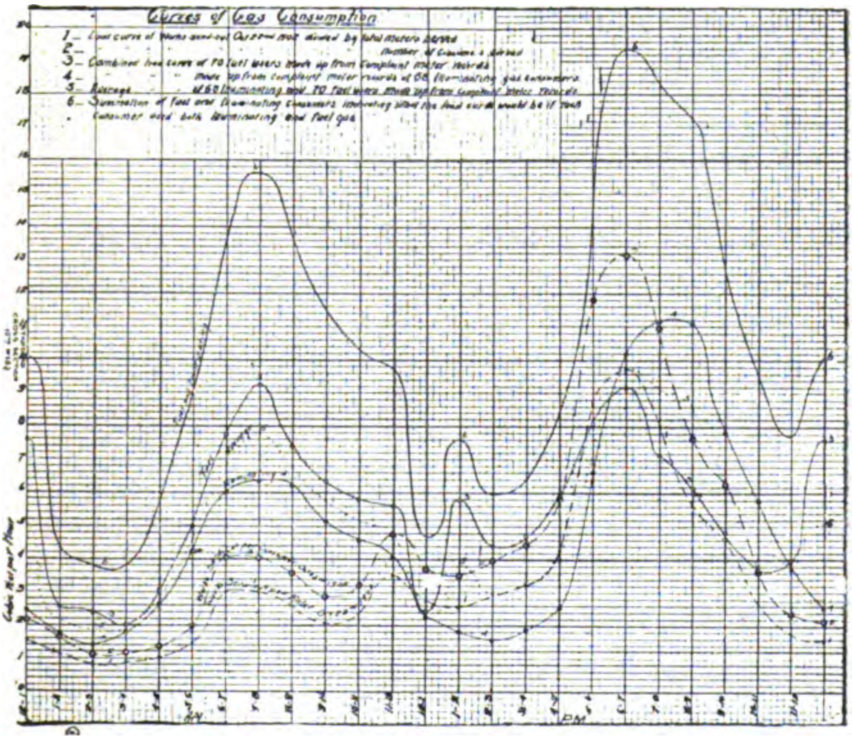


FIG. III.—MAXIMUM SEND-OUT OCTOBER 22, 1902.—DENVER GAS AND ELECTRIC COMPANY.

consumers are supplied from the same main it is hardly likely that their peaks will occur at simultaneous times, so in planning distributing pipe it would not be necessary to allow more than 75 feet per hour per consumer. As the number of consumers supplied by the same pipe is increased, the maximum demand can be diminished the greater the number, until only 20 feet per consumer must be allowed.

No. 113. Is portable testing of meters desirable?

PEORIA GAS AND ELECTRIC COMPANY:—Portable testing of gas meters is not desirable, as there are too many chances for the portable test meter to get out of order. To satisfy complaining consumers we check the registration of their meters by means of a Maryland Meter Company Recording Complaint Meter, showing the consumer at what hours he has used the gas charged to him and comparing the statements of the two meters for the time covered by the test.

GEO. KIRK:—Portable testing of meters is desirable.

THOS. D. MILLER:—Yes.

JOHN FRANKLIN:—I consider it such.

FREEPORT GAS LIGHT AND COKE COMPANY:—No.

No. 114. How often should consumers' meters be tested?

CHAS. S. RITTER:—There are two important reasons for maintaining consumers' meters at a high state of accuracy; the value to the gas company in moral influence, and the economy to the company in the saving of gas that passes unregistered through leaky valves and diaphragms.

The first is the more important reason; the second becomes very important only when the bookkeepers fail to watch carefully the state of the consumer's accounts, and to have investigations made of all extraordinary fluctuations, or no consumption bills, that cannot be satisfactorily accounted for.

We cannot depend on the consumers' ledger, however, to guide us in keeping our meters in good condition, and must, therefore, fix an arbitrary time for testing all meters that are not otherwise reached within this period. Three or four years, I believe, is the common practice, but many companies do not make routine tests quite so often and some not at all.

When carefully watched on the consumers' ledger, as suggested, the average error existing in the meters tested at the routine test will be very small.

Tables below represent the tests of 15,739 meters tested during the year of 1902. It will be observed that the average error was only 0.63 of 1 per cent. slow; a very good showing for the much but unjustly abused gas meter.

About 50 per cent. of these tests were routine, or inspection tests of meters that had been in use for four or more years; the balance were removal and special tests.

About all of the non-registering, and very slow, meters were discovered by examination of consumers' ledger.

RECORD OF METERS TESTED IN 1902.

Sizes. No. Lights.	Correct Number.	Fast. No.	Fast. Per cent.	Slow. No.	Slow. Per cent.	Average Error. Fast; per cent.	Average Error. Slow; per cent.
3	303	681	1.37	1,725	2.53	....	1.27
5	1,796	2,894	0.91	5,928	1.27	....	0.46
10	108	147	1.19	303	1.80	....	0.66
20	70	71	0.99	154	1.76	....	0.68
30	10	36	1.44	32	3.37	....	0.72
45	1	12	0.22	12	0.10	0.06	....
60	2	1	0.08	12	1.27	....	1.01
80	3	5	0.11	3	0.09	0.03	....
100	3	4	0.17	4	6.56	....	2.23
200	....	2	0.80	1	0.75	0.25	....
300	....	1	0.75	....	....	0.75	....
Pittsburg's	345	337	0.85	733	1.65	....	0.62
Totals ..	2,641	4,191	0.99	8,907	1.58	....	0.63

	Total Meters Tested. Number.	Total Meters Tested. Per cent.	Error; per cent.
O. K.	2,641	1.67	0.00
Fast	4,191	26.7	0.99
Slow	8,907	56.6	1.58
Grand total	15,739	......	slow 0.63

PEORIA GAS AND ELECTRIC COMPANY:—Consumers' meters should be proved at least once in three years. Even though the meter registers correctly, the cases should be painted that often.

GEO. KIRK:—At least once a year.

T. R. BEAL:—A consumer's meter should be removed and tested once in five years, as experience shows that under average conditions a meter is likely to need oiling or adjustment after this length of service.

THOS. D. MILLER:—Consumers' meters should be tested at least once every five years. Every meter should be tested before going out, and on its return, and record kept of same.

JOHN FRANKLIN:—Would recommend the testing of meters about every two years on premises. Is less expensive and much more favorable in results shown.

C. J. FOX:—Every three years.

No. 115. Should meters be locked or returned from vacant houses?

J. H. ENRIGHT:—I believe it is far better to remove the meter from not only vacant houses, but those that have discontinued the use of gas, as we find our meter account can be far more economically handled by doing so. We test the meters on removal, and if found O. K. and in good shape, paint them, and they are ready for use again.

B. W. PERKINS:—Meters should be removed when the house is vacated, as it stops any question of the incoming tenant being charged for gas used by previous occupants.

F. M. TRAVIS:—Would advise using lock union meter cocks and removing meters and locking up services.

V. L. ELBERT:—Both could be used advantageously. If the house is to be occupied in the course of a few days, I would lock the meter, otherwise, remove same.

P. S. YOUNG:—It is believed that locking, or effectually stopping the flow of gas from meters in vacant houses, is more economical than removing them. The cost of doing the former is about half of the latter. In addition to this, considerable amount of wear and tear of meters, caused by handling them, is saved, besides the cost of handling.

MASTIN SIMPSON:—I do not believe it good practice to leave your property at any time in such shape that you cannot hold some one responsible for it, hence I do not believe it good practice to leave meters in vacant houses: again, system in operation is everything, and the likelihood of inferior records and lost meters is very much greater where you do not follow a uniform practice, *viz.*, their universal removal where not used.

PEORIA GAS AND ELECTRIC COMPANY:—Consumers' meters should be removed from vacant houses when they have been set there over two years, and locked when they have been set for a shorter time than two years and there is a probability of their being used soon again.

GEO. KIRK:—Meters should be returned from vacant houses.

T. R. BEAL:—Meters in all except the larger cities (where tenants move frequently) should be returned and tested for the reasons that they can be better cared for in the shop, and the installation of a good looking meter commands more respect from the customer, besides giving the assurance of its correctness after a test.

THOS. D. MILLER:—Meters and connections should be returned from vacant houses. Junk thieves are too thick.

FREEPORT GAS LIGHT AND COKE COMPANY:—Returned.

JOHN FRANKLIN:—Bring home after a period of one month, or two at the latest, in order to save them from vandalism, also to test and use elsewhere.

C. J. FOX:—Returned and tested before using again.

HENRY B. LEACH:—Our practice is to remove meter when not in use.

No. 116. Are direct reading meters desirable? How much more are they worth?

IRVIN BUTTERWORTH:—It goes without saying that "direct" or "straight" reading meter dials, in which the figures at all times show completely and plainly through the holes in the dial plate, are desirable, as they would obviously decrease the number of errors in meter readings and could be much more easily read by consumers, who would then be more apt to keep tab of their consumption than when using ordinary meters. Meters equipped with them should be well worth the additional cost which the manufacturers propose, *viz.*, 30 cents each.

B. W. PERKINS:—Yes, and they ought not to cost any more than present indexes.

PEORIA GAS AND ELECTRIC COMPANY:—Direct-reading meters, we take it, mean meters in which only the figures of the statement appear. Such meters would undoubtedly cut down the number of mistakes made in reading meters, but we are not certain that they would cut them enough to make any appreciable difference in the cost of caring for complaints. The additional parts required to make a meter of this sort also mean more expensive repairs on the meters in use. The chief value of the direct reading meter lies in the fact that it might possibly induce consumers to check their gas bills with their meters each month and lead them to do

a little thinking for themselves on the subject of gas, which would be conducive to a better understanding between gas sellers and gas users.

THOS. D. MILLER:—Direct-reading meters are very desirable and well worth $1 each.

EDITOR:—I am sorry to disagree with so many eminent authorities upon the desirability of direct-reading meters. When manager of the Madison Gas and Electric Company, I installed some direct-reading Schallenberger watt meters. To the best of my memory, about 5 per cent. of the total number of meters read each month were of the direct-reading type. The balance had ordinary indexed dials. I always kept careful records of the number of errors made by each reader and the percentage of errors to meters read. I found that our meter-reading errors were in excess of other plants, and an investigation disclosed the fact that although only 5 per cent. of the meters were direct-reading, these direct-reading meters caused the majority of all the mistakes made. I do not pretend to explain the reason for this, but simply give the result of our experience.

I do not see any very crying need for direct-reading dials. Our errors in meter-reading in Denver run less than one error to the 1,000 meters read. One of the meter readers in Columbus, O., read over 23,000 meters between errors. Mistakes in meter-reading with fairly efficient men should not exceed two mistakes per 1,000 meters read. The majority of these mistakes should be located by the bookkeepers if any systematic means are in use for doing this.

The only argument I see in favor of the direct-reading dial is the possibility of inducing the consumers to read their own meters. If consumers can generally be induced to read their meters if furnished with a direct-reading dial, I will advocate its use. No sort of dial will make careless men careful. One meter-reader explained his errors in reading direct-reading meters by the fact that he depended upon the position of the hands entirely and in a direct-reading meter he did not have this position to guide him. Unless figures are very large and very plain, a closer inspection is required to read a direct-reading meter accurately. A good meter-reader can read an indexed dial accurately from a considerable distance. As far as I know, all direct-reading electric dials have been abandoned.

No. 117. Are iron meter cases desirable?

PEORIA GAS AND ELECTRIC COMPANY:—We cannot see where cast-iron meter cases are desirable. If proper care is exercised in setting a meter, and if it is brought into the shop, proved and painted every three years, the tin-cased meter will earn just as much money as its cast-iron-cased brother. The tin-cased meter is easier to repair than the cast-iron meter, so that since they both will require the same amount of attention so far as registering correctly is concerned, the frequent painting of the tin will be offset by the difficulty experienced in getting the cast-iron meter joints tight.

GEO. KIRK:—Iron meter cases are desirable on heavy pressure mains.

THOS. D. MILLER:—Iron meter cases are not desirable.

JOHN FRANKLIN:—Desirable, but too expensive.

C. J. FOX:—Yes, if you can afford them.

EDITOR:—Cast-iron cases have been almost universally adopted by electric meter makers. They are more durable, will often go through a fire without damage, and present a better appearance, which seems to inspire greater confidence on the part of the public. The Glover type of gas meter is too large to adapt itself readily to a cast-iron case, but I think improvements to meters will be along the line of reducing the size without decreasing the capacity.

No. 118. Are iron meter connections preferable to lead, and if so, why?

V. L. ELBERT:—No.

MASTIN SIMPSON:—My answer to this question is, No. I believe in an iron inlet and in a lead outlet, the latter containing about 12 inches of lead. The former gives a rigid connection to stand the strain of the stop-cock, while the latter affords all the necessary latitude due to the exchange in make and ordinary size.

PEORIA GAS AND ELECTRIC COMPANY:—We prefer lead connections. The only advantage in using iron connections is that the fitter cannot kink them, but the fitter who will kink lead meter connections is just the man to rip off the meter pipes in trying to make his iron connections meet, so that with careless fitters one is as bad as the other and with careful fitters the advantage lies with the lead connections.

Geo. Kirk:—Iron meter connections are preferable on meters from 10-light up, as the supply is freer.

T. R. Beal:—Iron connections are not desirable unless a few inches of lead are used, either on the inlet or outlet side, to prevent strain on the meter. With this precaution they are cheaper and preferable.

Thos. D. Miller:—Iron meter connections are not desirable. Lead is far preferable.

Freeport Gas Light and Coke Company:—No.

F. W. Stone:—Yes. Cheaper. Easier put up. Meters and connections take up less room. Do not need shelf for smaller sized meters. If meters are hung with a swing, can change the size without disturbing any part except brass spuds.

John Farnklin:—Lead by all means. Every point in its favor.

C. J. Fox:—Yes. Will not kink or break. If left in empty houses will not be stolen. Less expensive.

Editor:—It looks like a chance for an argument here.

No. 119. Has any member had unfavorable experience with the Hickenlooper coating for services (see *A. G. L. J.*, Vol. 65, p. 888; Proc. Am. Gas. Lt. Assn., Vol. 13, 1896, p. 188), and if so, what are the details of such experience, and if other kind of coating is being used, give details of experience with it. Where Hickenlooper coating is being used, how old is the oldest service so coated and still in existence?

Geo. Kirk:—This company coats service pipes with coal-tar, applied to heated pipe (heated by exhaust steam) and finds the same very satisfactory. Services in use now which were laid 35 years. Soil is sandy.

Thos. D. Miller:—Hickenlooper coating for services is but of little avail where electrolytic action exists. This is the only unfavorable experience I have had with it.

John Franklin:—Have never had occasion to change my opinion on this point. Have examined service pipe that has been coated 25 years ago that is removed to make room for a larger one, and found it in very fair condition. I consider the life of any service, coated or not, depends entirely upon the conditions of the ground it is imbedded in. If properly coated with General Hickenlooper's prepared tar and service laid in good gravel ground would consider it good for 25 years.

EDITOR:—The writer had made an investigation of this problem by correspondence prior to the time this question was put into the box. It is now too late to get permission to insert the replies given and I therefore will take the liberty of inserting the replies without giving the names of the companies from whom they were rceived.

No. 1 says: We could not see that Hickenlooper coating protected our services in the least and have therefore abandoned it.

No. 2 says: We do not use the Hickenlooper coating. We use a coating of coal-tar, which has been previously heated up with lime to neutralize the acid, painting fresh tar over such portions of the pipe as are uncovered by the tongs. We have obtained very good results from the use of tar.

No. 3 says: We use pyro-paint made by the Phœnix Paint Company, of Cincinnati, but have had no opportunity as yet to see how it will last underground.

No. 4 says: We have no trouble with electrolysis, except at one point. Our service in this locality has been eaten out two or three times in the past two years. We have now covered this service with a piece of rubber hose at the point exposed to electrolytic action.

No. 5 says: We have abandoned the use of Hickenlooper coating and are using coal-tar turpentine and a little pulverized lime.

No. 6 says: Hickenlooper coating gives excellent results. We have had no trouble with electrolysis.

No. 120. What is the relation of the actual capacity to the nominal capacity of meters of different sizes and makes?

GEO. KIRK:—About three to one.

W. B. TUTTLE:—The relation of the nominal capacity of any gas meter to the actual capacity is determined by the volume of gas which the meter will pass without a drop in pressure, between the inlet and outlet, sufficient to materially affect the efficiency of burners or fuel appliances.

Assuming that the minimum pressure on a system of mains is 2 inches and that the minimum pressure at the burner should be 1.5 inches, the capacity of a meter under such conditions is limited by the amount of gas it will supply with a drop of not more than

0.5 inches between the inlet and the outlet. It is assumed, in making this statement, that the pipes to and from the meter are of ample size, so that the pressure at the meter inlet will be practically the same as the pressure at the burner.

Since gases of different specific gravities flow through a given orifice at different rates under the same pressure, the capacity of a meter will be greater with coal-gas than water-gas.

The following tests were made on Maryland and American meters, three lights, five lights and ten lights.

These meters had all been in use and were taken apart and put up in the best physical condition, and were all adjusted correctly.

A mixture of coal-gas and water gas of about 0.5 specific gravity, as shown by Schilling's specific gravity apparatus was used.

A 10-foot meter prover, set to throw 2 inches pressure, was used to measure the volume of gas passed in each case and the rate at which the power descended was taken with a stop watch.

A U-gage was connected to the inlet of the meter.

A piece of pipe about 3 feet long was connected to the meter outlet in each test. To the upper end of the pipe a union was connected and to close the opening of this various plates were drilled with different numbers of small holes, ranging from one to 20.

By this means the rate of flow of gas through the meter was controlled.

A King's arch gage was connected on the pipe about 6 inches above the meter outlet and the pressure shown on this gage, at the different rates of flow was noted. In the following tables are the records of the various tests. On account of the numerous cases where pipes are small and when in consequence a considerable drop in pressure takes place between the meter and the burner, it is probable that in actual practice a drop of not more than 0.25-inch should be allowed at the meter. The capacity of the meter tested may therefore be assumed to be as follows:

Size	3 lights	5 lights	10 lights
Maryland ...	52.9 cu. ft.	66 cu. ft.	85.6 cu. ft.
American ...	51.9 cu. ft.	81.8 cu. ft.	90.2 cu. ft.

TEST OF THREE-LIGHT METERS.

(Inlet pressure, 20-tenths.)

No. Holes Passing Gas.	American. No. 626.		Maryland. No. 1,258.	
	Gas Passed per hour; cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.	Gas Passed per hour; cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.
1	6.5	0.0	6.1	0.0
2	13.8	0.0	13.5	0.25
3	20.3	0.5	20.2	0.5
4	27.6	1.0	27.6	1.0
5	34.1	1.25	34.1	1.5
6	40.0	1.5	40.0	2.0
7	46.1	2.0	45.0	2.25
8	51.9	2.5	52.9	2.5
9	56.0	3.0	59.0	3.0
10	62.1	3.5	66.5	3.25
11	69.2	4.0	72.0	3.5
12	75.0	4.5	78.2	4.0
13	81.7	5.0	81.6	4.5
14	....	...	85.8	5.0

TEST OF FIVE-LIGHT METERS.

(Inlet pressure, 20-tenths.)

No. Holes Passing Gas.	American. 691738.		Maryland. No. 458669.	
	Gas Passed per hour; cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.	Gas Passed per hour; cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.
1	6.1	0.0	6.4	0.0
2	13.7	0.0	14.5	0.0
3	20.2	0.25	21.2	0.5
4	28.1	0.5	29.2	0.75
5	34.4	0.75	35.2	1.0
6	41.8	1.0	43.9	1.25
7	48.2	1.25	49.3	1.5
8	54.4	1.5	55.2	1.75
9	60.0	1.75	60.0	2.0
10	66.5	2.0	66.6	2.5
11	75.0	2.25	74.9	3.0
12	81.8	2.5	83.6	3.25
13	88.0	3.0	89.0	3.5
14	93.4	3.75	94.7	3.75
15	98.8	3.5	100.0	4.25
16	104.3	4.0	105.9	4.5
17	112.5	4.5	112.4	4.75
18	120.0	5.0	120.0	5.0

TEST OF TEN-LIGHT METERS.

(Inlet pressure, 20-tenths.)

No. Holes Passing Gas.	American.		Maryland.	
	Gas Passed per hour: cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.	Gas Passed per hour; cu. ft.	Drop in Pressure at Meter Outlet. Tenths of inch.
1	6.3	0.0	7.0	0.0
2	14.1	0.0	14.8	0.0
3	21.2	0.5	22.5	0.25
4	27.6	0.75	29.0	0.5
5	36.0	1.0	36.0	0.75
6	45.0	1.25	45.0	1.0
7	48.7	1.5	48.5	1.25
8	59.0	1.5	58.0	1.50
9	63.2	1.75	62.6	1.75
10	71.9	2.0	70.6	2.0
11	80.0	2.25	78.2	2.25
12	90.2	2.5	85.6	2.5
13	94.6	2.75	90.1	2.75
14	67.4	3.0	94.6	3.0
15	103.0	3.25	100.0	3.25
16	116.0	3.5	115.0	3.50
17	120.0	3.75	120.0	4.0
18	128.4	4.0	128.0	4.5
19	133.2	4.5	133.2	5.0
20	138.0	5.0	.....	....

ANONYMOUS:—The following tables of results give some tests on various sizes of meters at 0.5-inch differential pressure between inlet and outlet of meter. It will be noted that the rating on a capacity basis is entirely different from the customary rating.

Two new lists are also given, list "F" giving the list prices of various sized meters in their capacity relation to a 20-light meter. List "G" gives the list prices for various sized meters on a basis of a fixed charge of $2 per meter plus the list based on their capacity relation to a 20-light meter, which in itself has $2 subtracted from its list price. (See table.)

COMPARISON OF CUSTOMARY METER RATING WITH THAT BASED ON TWENTY-LIGHT METER.

Makers Rating. No. Lights.	Manufacturer. Name of Meter Co.	Actual Capacity at 5 Different Pressures. Cubic Feet per Hour.	C ÷ 20 Lt Capac. 20 lt. Meters in cu. ft., per hr. = Md...240 Am...263.1 Per cent.	20 × D / No. Lights. New Rating Based on Capacity of 20-light Meter.	New List Price Based on E. $16.50 × C ÷ 240 (Md.) [or 263.1 (Am.)]	New List Price Based on E. ($16.50 — $2) × C ÷ 240 (Md.) [or 263.1 (Am.)] + $2.	Manufacturer's List Prices. Per Meter.	Manufacturer's List Prices. Per Cubic Foot per Hour. H ÷ C	Manufacturer's List Prices. Per Light. H ÷ A	Capacity per Light, Present Rating Cubic Foot per Hour. C ÷ A
A	B	C	D	E	F	G	H	I	J	K
3	Maryland	71.3	29.7	5.94	$ 4.90	$ 6.30	$ 7.50	$0.105	$2.50	23.4
3	American	75.2	28.5	5.70	4.70	6.14	7.50	0.099	2.50	25.2
5	"	125.2	47.5	9.50	7.83	8.93	9.50	0.075	1.90	25.0
10	"	125.4	47.2	9.44	7.78	8.88	12.00	0.095	1.20	12.5
30	Maryland	270.9	112.8	22.56	18.61	18.36	22.50	0.083	0.750	9.0
30	American	342.0	129.9	25.98	21.43	20.80	22.50	0.065	0.750	11.5
45	"	451.1	171.4	34.28	28.28	26.86	33.00	0.073	0.733	10.0
60	Maryland	501.9	209.1	41.82	34.50	32.32	45.00	0.089	0.750	8.3
80	"	677.8	282.4	56.48	46.59	42.95	62.00	0.091	0.775	8.5
100	"	722.8	301.1	60.22	49.68	45.66	75.00	0.103	9.750	7.2
150	"	1,153.8	480.7	96.14	79.31	71.70	115.00	0.099	0.764	7.8
150	American	1,048.9	398.6	79.72	65.76	59.80	115.00	0.109	0.764	7.0

[Note.—Column **D** is calculated on the assumption that a 20-light Maryland Meter Company meter passes 240 cubic feet per hour or 12 cubic feet per light. Dividing column **C** by 12 will give the figures in column **E** for that make. The first figure in column **E** is thus obtained: 71.3 ÷ 240 × 20 = 5.94. Similarly for the American meter, which passes 263.1 cubic feet per hour. We have taken the liberty of rearranging and condensing this table for the sake of clearness.—Ed. Prog. Age.]

E. J. SHERWOOD AND L. G. VAN NESS:—I have tested the meters tabulated below in the first column and find their capacity to be as tabulated in the last columns. The tests were made under working conditions, the pressure used being 27-tenths at the inlet and 22-tenths at the outlet, the fluid used to make the tests being ordinary city gas.

CAPACITY OF METERS FROM VARIOUS MAKERS.

No. Lights. Size.	Maker.	Capacity per hour. Cubic feet.	Capacity per Light Cubic feet.
3	American	70.56	23.52
3	McDonald	76.16	35.38
3	J. J. Griffin	66.36	22.12
3	Harris Griffin	63.40	21.13
5	McDonald	101.40	20.28
5	Maryland	107.44	21.48
5	American	106.66	21.33
5	Harris Griffin	97.28	19.45
5	Griffin	98.62	19.72
10	McDonald	155.17	15.52

It seems as if testing meters under 0.5 pressure at the inlet and atmospheric pressure at the outlet is not under working conditions and neither would it be under working conditions if the meters were tested with any other fluid than city gas. I was unable to carry the test further than the 10-light meters on account of not having meters in stock.

No. 121. Why will a stop-cock, service or meter, always work well without lubrication?

V. L. ELBERT:—Being a ground joint, they do not require lubrication.

MASTIN SIMPSON:—A stop-cock will *not* always work well *with* or *without* lubrication. My experience with stop-cocks has been most unsatisfactory. In Newark we used stop-cocks for anything from 1.25 inches down. From 1.5 inches up we used an iron gate valve with square nut for wrench. We found this most satisfactory. Figuring on 5,000 services for a year and an additional cost to include extra labor, stop box, cock, etc., the minimum expense would have been $5,000. During the year I have in mind

we put in 5,000 services and over; our total expenses incurred because we had no stop-cocks was $140. This expense was incurred in cutting off customers, fires, etc. The saving to the company was apparent.

JOHN FRANKLIN:—My experience has been that unless a service or meter cock is well greased with a good solid mixture of tallow and beeswax, it does not retain its lubricating properties very long.

C. J. FOX:—Oil in gas keeps them in condition.

HENRY B. LEACH:—Until we obtained a self-lubricating gas cock, we never had one that would not stick, after being in use any length of time.

No. 123. What is the best pressure at which to sell and distribute gas?

B. W. PERKINS:—Three inches.

T. R. BEAL:—In order to satisfy existing conditions of piping and fixtures (old pipes, etc.), and also to suit present practice, a pressure of about 1.8 has been found advisable.

FREEPORT GAS LIGHT AND COKE COMPANY:—Must be determined by capacity of distributing system necessary to maintain 2 inches, consumers' meter.

JOHN FRANKLIN:—Depends upon conditions.

No. 124. When care is taken, what should be the average loss of gas from mile of main? From mile of service?

GEO. KIRK:—None.

FREEPORT GAS LIGHT AND COKE COMPANY:—Forty-nine thousand per mile of main, not taking into consideration mileage of service.

EDITOR:—I have never seen any attempts to compute loss of gas per mile of service. Leakage is often more affected by the station meter than by the efficiency of street men. It is generally considered good practice if leakage does not exceed 100,000 feet per mile of main reduced to a 3-inch basis.

No. 125. How would you prevent small gas leaks, too small to affect the size of the gas bill, but which do affect the consumer's peace of mind?

Geo. Kirk:—Have pipes well tested before turning gas on.

John Franklin:—Notify owner to have gasfitter test his house lines with air pressure, locate by ether and soapsuds and repair same.

Freeport Gas Light and Coke Company:—Repair them.

Geo. MacMillan:—Would depend on conditions—but gas smell should be removed.

Henry B. Leach:—We should prevent small leaks by stopping them as soon as reported.

No. 126. What is the best pressure to carry on a distributing system where no trouble is experienced in maintaining a uniform pressure throughout the system?

Geo. Kirk:—Three inches pressure.

John Franklin:—Thirty-five to 40-tenths.

Geo. MacMillan:—Should say 20-tenths.

No. 127. Has anybody tried a thin coating of cement, applied with a brush, for preserving wrought-iron gas pipes?

John Franklin:—Never have. Use tar coating.

J. D. Shattuck:—Would say that we have poured cement on pipe and have also covered it to a depth of 0.25 inch. We believe that cement coating of about 0.25-inch thickness will entirely overcome electrolysis. Our pipes are lying next to cement-covered water pipe and the water pipe is not being damaged at all, while we have more or less trouble from electrolysis. What is wanted is some economical way of putting the cement on the pipe of this thickness.

J. A. Dixon:—Although we have never put on cement coating in just the way referred to, that is, a thin coating with a brush, we do make a general practice of laying all our wrought-iron lines for high-pressure gas in cement protection. We construct a cheap trough, which is placed under the pipe after it is laid in the trench, and the pipe is held centrally in the box by small pieces of brick or briquettes made from cement. We find it necessary to have this coating on the pipe not less than 1 inch in thickness for any size up to 2-inch pipe, this thickness being required to prevent cracking. We always find it advisable to use the very best grade

of cement. Much of our pipe is naturally laid in railroad yards and frequently through cinder filling, and we find this coating not only withstands the corrosive influence of such filling, but also good protection against stray electric currents.

ERNEST F. LLOYD:—In general a cement wash is considered an excellent preservative of iron or steel. I have known of its being so used on the inside of an iron vessel where no oil paint would stand, and to have been wholly successful. I am under the impression that it is quite largely used for this purpose in the navy.

No. 128. Does it pay to make service connections to gas mains by means of swing joints made up from street tees and street ells? (The main is tapped on the top, the street tee screwed into it, and the street ell screwed into the street tee at side. The top opening in the tee is used to cut off the gas from the service while it is being laid, and also for examining the service in case of trouble.)

MASTIN SIMPSON:—I believe it does. It makes the operations safe while the work is in progress, relieves the pipe of both vertical and horizontal strain due to settling or crawling and makes it very much easier to repair, renew or enlarge the service.

JOHN FRANKLIN:—Consider top hole great objection and fittings more so; always extend from side hole in main, give service good grade and block well unless the main is very deep, then use easy bend screwed into the top of main.

WALTON FORSTALL:—The extra cost of the street tee and street ell, as expressed in a percentage of the total cost of the service, is so small that I am of the opinion it does pay to use these two fittings.

GEO. MACMILLAN:—In clay soil would say yes; in sandy soil unnecessary.

FRANK HELEN:—I believe it does pay to use swing-joints made up from street tees and street ells for the following reasons:

An inexperienced man can tap main, and, by using the swing-joint made up from street tees and street ells can easily give the service the proper drip to main—thus avoiding unnecessary strain on the main or threads on the service pipe.

Without swing-joints tappers must be extremely careful to tap the main to a level in order to give service the proper drip to main and avoid unnecessary strain on main or threads on the service pipes.

The above refers particularly to shallow mains, where the action of the frost renders frequent breakages.

We find six cases out of ten that the break has occurred at the point where service is connected to the main—and the use of the swing-joint allowing greater contraction and expansion renders breakage less frequent.

No. 129. Do you ever have trouble from stoppage of nozzles of gas arcs supposed to be caused by paint in the interior of gas mains? Is there a remedy?

FREEPORT GAS LIGHT AND POWER COMPANY:—No.

JOHN FRANKLIN:—Not worth mentioning.

W. H. BARTHOLD:—Don't believe that any such trouble exists. Samples submitted said to have been caused in this way are believed to be the result of unclean or unfixed gas.

No. 130. What is the best tip for Batswing burner?

JOHN FRANKLIN:—Consider the Bray as good as any.

GEO. WHYSALL:—Recommend the use of aluminum tips for shops, factories, etc., and lava tips for stores, dwellings, etc.

No. 131. It is proposed to lower into a ditch 20 feet wide and 25 feet deep, six-ton pipe (60 inches in diameter) and 7.5 ton valves, with a tripod with crab attached. The banks are of loose earth. How would you plant the legs quickly and insure perfect safety?

GEO. KIRK:—Would put a 3-inch plank under each leg and cleat behind the leg to prevent slipping.

JOHN FRANKLIN:—Thoroughly plank and brace your sidings, then have your derrick on wheels, allowing the wheels on the legs to run upon good heavy timbers.

B. W. PERKINS:—I would suggest that a single gin pole, guyed at the top with four guys, be employed as a support, and for lifting would suspend a pair of three sheave blocks from the top running the full line through a snatch block secured to the bottom of the pole with chain and then to a capstan set at a safe distance and operated with team of horses. This outfit can be

rigged to lift any weight, and if the guys from the top are fastened to anchorages with tackle, it can be inclined at any reasonable angle.

FRANK HELEN:—This, to my mind, is not a question of quickness, but rather a question of personal safety of employes.

If tripod is to be used on ground surface I would ascertain from the nature of the soil the proper distance from the open trench where the legs of the tripod could be set with safety and all danger of a possible caving in of the loose dirt of either bank avoided.

If I were to do this work in a ditch 20 feet wide, I would lower pipe on an incline, using timbers of required strength. Drive a stake in the solid bank. Fasten end of rope securely to the stake. Wrap once around pipe from under side and attach other end of rope secure to another stake driven in bank. Lower pipe slowly by playing rope out around the stakes. Lower valves in same manner. When same are in the bottom of ditch use a small tripod and triplex lifting block to place pipe and valves in proper position.

No. 132. It is proposed to cut a line of pipe 48 inches diameter or over to place a special. How would you do it to insure a good cut.

JOHN FRANKLIN:—Diamond both in and out.

FRANK HELEN:—Cut deep into the whole circumference of the pipe with a diamond-point chisel. Encircle again with a sharp cold chisel, then continue in the same manner with a striking chisel and sledge hammer until the pipe cracks. This will insure you a good cut.

GEO. WHYSALL:—By the use of a diamond and dog chisel.

No. 133. Do you think it necessary to diamond-point pipe of any size before applying dog-chisel when you want to cut it in two (outside of trench)?

MASTIN SIMPSON:—If the pipe can be rolled on skids I do not think it necessary to use a diamond point. With two hammers and a good dog chisel we have made good clean cuts in 20 and 24-inch pipe in from 12 to 16 minutes. Our practice was to make a fine mark on the pipe with a slate pencil, making the first

round with a chisel a simple scarring on the pipe, and in the channel thus cut the other round was made with good hard driving, with the results above mentioned.

GEO. KIRK:—Yes.

JOHN FRANKLIN:—It is advisable to diamond-cut all sizes to insure a good clean break.

GEO. MACMILLAN:—We never use diamond under conditions stated.

FRANK HELEN:—If the pipe is not cracked, it is not necessary to use a diamond point, but if it can be cut with a dog chisel (we call it a striking chisel).

Where the pipe is 8 inches or smaller size, if cracked lengthwise you should start cut about 6 inches from end of crack and use diamond point on entire circumference of pipe.

Where pipe is larger we use diamond point, beginning about 6 inches from end of crack, using same round only 12 inches of the circumference on same side as crack, and then use a striking chisel the remainder of the circumference.

When striking chisel is used on entire circumference of pipe the crack is liable to extend.

WM. H. COOPER:—It is not necessary to diamond-point pipe or use a chisel. Get a Hall cutter and cut as you would wrought-iron pipe.

NO. 134. Is it good practice to use hat flanges and hub sleeves generally, instead of crosses and tees in making connection to trunk lines at intersections?

GEO. KIRK:—Use crosses and tees under 16 inches.

WALTON FORESTALL:—I consider it good practice to use hat flanges and hub sleeves wherever the main to be cut is very large and the connecting main is 12 inches or under. In laying 30-inch line to be connected to 6-inch mains at every intersection, it is our practice to make the connection by means of a hat flange instead of using a 30-inch by 6 inch tee or cross. The hat flange connection is much less expensive and means fewer joints in large mains.

JOHN FRANKLIN:—Consider hub and spigot fittings most preferable.

GEO. MACMILLAN:—In a few instances tried, the hat flange and hub sleeves worked out satisfactorily and gave no after trouble.

FRANK HELEN:—I believe it is not good practice to use hat flanges.

I think when a trunk line is laid that crosses and tees should be put where branches will be required in the future.

Where no provision is made for future extensions we use a split sleeve with side outlet (sometimes called split-tee).

The expense of placing this fitting will not exceed one-half the necessary expense involved by cutting the line and placing solid tee and also lessens the risk from breakage of rubber gas bags. Split-sleeves with wide outlet are to be used only where tees are necessary. If a cross is required I would cut the line and place one.

No. 135. In piping houses, is it worth while to pay the additional cost for genuine wrought-iron pipe over merchant pipe in order to have less leakage and less wear on tools?

HENRY B. LEACH:—We say yes, and think that the wear on tools will more than pay the difference in first cost.

WM. H. COOPER:—It certainly does pay to put in wrought-iron instead of steel anywhere.

J. D. SHATTUCK:—I believe that it pays to pipe houses with wrought-iron pipe and all inside piping 0.75-inch and above to be what is known as line pipe. We use this line pipe for high-pressure work and believe it would pay to extend it to service work, stove work and house-fitting work. The threads are longer and the sockets and fittings have longer threads cut with a much better fitting taper and we have found that a line pipe joint can be made up without jointing material and be tight and remain tight, although I do not carry this out in practice. The line pipe will cost nearly 10 per cent. more than the ordinary merchant pipe.

GEO. WHYSALL:—Prefer wrought-iron pipe for the reasons mentioned in the question.

No. 136. What is the most economical initial pressure for a pressure line to boost up pressure through a distributing system. Say, 150,000 cubic feet per hour?

No. 137. Will ground, saturated with tar around the lead joint of a cast-iron main, help to prevent leaks?

B. W. PERKINS:—Do not think that saturating the ground around the joint of a cast-iron main would be of any use other than to preserve the pipe. Do not think it would have any tendency to prevent leaks.

No. 138. Can the present type of Connelly street main governor be adjusted to maintain a given pressure when one or more lifts of the gas holder are in use?

GEO. G. RAMSDELL:—The balance governor should always be placed ahead of the Automatic when using holders of different pressures or telescope holders.

B. H. PETLEY:—The Connelly governor cannot be adjusted to maintain a given pressure on street mains with a change in holder pressure, so long as the adjustment is dependent upon the transfer of mercury from one vessel to another. As the holder pressure changes, the governor valve must necessarily raise or lower, which causes a transfer of mercury and a variation in pressure that cannot be avoided.

No. 139. What is the best means of taking care of contraction and expansion of bridge pipes?

B. W. PERKINS:—We have in use in this city 500 feet of 16-inch pipe suspended from the center of floor of a bridge, the expansion and contraction of which are taken up with a single expansion joint in the center. As it has been in use nearly two years, has given no trouble and fills the bill perfectly, would suggest this as an answer to the question.

F. W. BLOWERS:—We assume that the question refers to pipes crossing a bridge. The best means, in our opinion, is the use of the Dresser sleeve.

GEO. WHYSALL:—The use of expansion sleeves.

No. 140. Has anyone tried the use of paper conduits to protect surface pipes from electrolytic action?

No. 151. What is the best method of caring for and filing complaints?

IRVIN BUTTERWORTH:—This is largely a matter of opinion, but in a general way, the best method should have about the following features, among others:

(1) A book in which every complaint is entered with full particulars as to name, address, date, time, character, name of man sent to remedy it, time sent, date and time trouble was remedied, and what was done to remedy it.

(2) Printed order slips giving trouble-man his instructions, and containing blanks for his report of what was done and when and for the signature of the complainant, certifying that the trouble was remedied.

(3) A return postal card to be sent to each complainant, asking if the trouble has been satisfactorily remedied.

(4) A trouble-men's record, monthly and accumulative, to be compiled and bulletined monthly, showing the number of complaints attended by each man and the percentage of those that were satisfactorily attended to on first visit.

(5) A polite, intelligent, level-headed and good-natured complaint clerk, with plenty of assistants and office facilities for giving each complainant proper, courteous attention.

B. W. Perkins:—Alphabetically arranged in filing cases.

P. S. Young:—Geographical card index file for attended-to-complaint cards.

C. J. Owen:—Any card system that will furnish a carbon copy bearing some reference number, the original to be sent out as order for execution and report of condition before and after completion of work; then to be filed away for future reference, alphabetically indexed from consumer's names; the carbon copy to be held at office as a check on return of the original, after which it may be filed in alphabetical street order when consumer's name is not given.

R. C. Allen:—I would adopt an order printed in duplicate, retaining the carbon copy in the office for reference should the original be misplaced or lost.

These complaints should be numbered for convenience in filing. The form should employ the complainants name and address, time the same is received in the office and the nature of the complaint, together with an additional space for the trouble-man's memoranda, that is, the hour he takes the order, nature of the trouble corrected, customer's signature after same has been attended and the time the order is completed.

These orders are to be removed from the order book by the trouble men and their signature on the carbon copy fixes the responsibility in case the order is overlooked or neglected. Each

day's orders are sent to the superintendent's office, giving him an opportunity to locate any irregularities in the service which might not be reported, as well as keeping a check on the trouble men.

PEORIA GAS AND ELECTRIC COMPANY:—The best method of filing complaints is to use the card system in handling them. Use duplicate cards made of paper thin enough to use carbon sheets for making the duplicate. Upon receiving a complaint the duplicate cards are filled out with the address, the name of the consumer and the nature of the complaint, together with the time of its receipt. The duplicate is temporarily filed in the office under the name of the consumer to keep a check upon the complaint department and the original is sent to the complaint department. When the original is returned to the office after the complaint has been remedied, the duplicate is removed from the temporary file and filed by the date of completed work until end of the month, when monthly report is made out and duplicate destroyed.

The original is filed in a permanent file under the street address, so that all the complaints coming from any one premises are kept together and gives a means of determining when the company's mains, service or meters in any locality need attention.

JOHN FRANKLIN:—When not too numerous, record each complaint so same can always be referred to when again received.

No. 152. What are the advantages or disadvantages of Loose Leaf Consumers' Ledgers *vs.* Bound Registers?

R. C. ALLEN:—Loose leaf ledgers are advantageous for the reason that most companies have their customers' accounts routed and the bookkeeper is compelled to guess at the amount of space to leave for the probable increase in business during the year and should the increase exceed that anticipated, if often leaves his ledger either too small or his accounts are in such shape as to require a great deal of additional work. It frequently happens that a company will make a number of extensions, thereby greatly increasing the number of accounts in one of the ledgers and the bookkeeper finds that he is unable to take care of the work. Should such be the case he can remove as much of his ledger as is necessary and give the account to some one who has fewer accounts, or each of the ledgers can be reduced and a new ledger opened, which could not be done with the old style books.

FRANK W. FRUEAUFF:—Below, briefly stated, are some of the points of advantage of these methods with some conclusions arrived at after experience with both systems. In my deductions I assume that the bound registers are those with accounts running across the page, as I do not feel that there can be any advantage in the bound registers that have accounts running down the page.

The following points are favorable to the bound registers:

(1) Time saved in footing book (getting month's revenue). There is a big advantage in the bound book, as the accounts appearing one below another on the page, are easily totaled and carried forward. With the loose leaf system they must be drawn off on a blotter and footed or taken off on an adding machine. turning a page each time. (Of these two ways, the "drawing off" on blotter and adding is safest and best, as you have a complete record that is easily checked in case of an error in the monthly balance.)

(2) Time is saved in posting cash. As a number of accounts appear on each page, less time is required to find and post an account.

(3) Easier to balance. The bookkeeper has much less trouble in getting his balance each month, as it is easier to check back the work and there is less likelihood of an error in drawing off the revenue originally or in overlooking a posting.

(4) Time saved in taking off the list of delinquent accounts. This being an account of number of accounts appearing on each page.

The following points are advantages resulting from use of loose leaf ledgers:

(1) Time saved in billing. All accounts appearing in the order in which meters are read, no time is lost in turning to new accounts which are out of place. This trouble becomes worse as the year goes on and until the book is transferred and accounts rearranged.

(2) Time saved in entering orders. The same arguments as for reason No. 1 will apply—no trouble to find account.

(3) Accounts are always in place. This is a great help in reference to the book in getting special information regarding an account or in putting a new man in unfamiliar territory.

(4) Advantage for combined gas and electric companies. The loose leaf books have a special advantage for combined com-

panies in that by the use of different colored leaves all accounts, gas or electric, can be kept in order. This is a great help in billing, as the accounts of each consumer will appear together and are made up at one time and posted when paid without reference to two wooks. No suitable leaf has been made, in book form, that will serve for a combined gas and electric account and cover a period of one year.

(5) A better record of consumer's account. The item appearing one below another on the leaf are more easily understood and there is less likelihood of a mistake in deducting one reading from another than in subtracting across the page. A record can be kept on one leaf for a period of four or more years, this being an advantage in reference in case of dispute or misunderstanding. Any abnormal increase or decrease in a consumer's account is more easily noted, and therefore more likely to be verified before the sending of bill, where the items appear one under the other.

To draw a few conclusions from the above conditions, I believe that for a company rapidly increasing its number of consumers, or in cities where the population changes frequently, it is, on the whole, an advantage to use the loose leaf system. With combined gas and electric companies the advantage of this system is also great. The item of cost between the two systems is not sufficient to make it an object to adopt the one or the other, although the loose leaf system may be slightly cheaper. For a small company, operating only a gas or electric plant, I believe the bound registers would be found the most desirable.

W. B. Tuttle:—The advantages of the loose leaf consumers' ledger over bound ledgers are that leaves for consumers which are added from time to time can be placed into the ledger at any time and that ledgers may be subdivided at any point, if it becomes necessary to put on additional employes for any reason. Dead accounts can also be removed. The disadvantage of the loose leaf consumers' ledger is that it is somewhat more difficult to keep an index of the consumers.

No. 153. If you have not adopted the system of uniform accounting recommended by the committee of the American Gas Light Association, what are your objections to it?

F. W. Blowers:—This company has not adopted the system of accounting recommended by the committee of the American

Gas Light Association for the reason that, in our opinion, it is too complex and not suited to the requirements of a company of this size, and we do not think a uniform system of accounting can be successfully used by all companies.

No. 201. What developments have been made in domestic laundry appliances?

E. J. Fox:—Instantaneous water heaters, laundry stoves, gas irons.

E. Haase:—Under the head of Domestic Laundry Appliances, the equipment of laundry dryers for apartment buildings might be reported. In a building of 24 apartments, the six dryers in the laundries were equipped to use gas instead of hard coal by inserting a 1.25-inch pipe burner 6 feet long and adjusted to consume 70 feet per hour. Over the burner there is provided a canopy to prevent the flames from striking the clothes, and also to spread the heat. The dryers are six sections each, and contain 28 feet of line per section. For boiling clothes and heating irons an ordinary two-hole hot plate is provided, one hot plate to each dryer. Records, accurately kept for two months, show that the gas consumed per washing averaged 300 cubic feet. The owner of the apartment building is perfectly satisfied with the cost of the operation of the laundries with gas, and the tenants are highly pleased. The same equipment is being introduced into other apartment buildings.

No. 202. What is the spherical candle-power of 16 candle-power Bray burner? Same, Welsbach?

No. 203. Why are not electric gas lighters in more general use?

Irvin Butterworth:—I will venture the following answers to this question:

(1) The decreasing use of open gas jets.

(2) The relative difficulty, expense, unsightliness and unreliability of electric gas lighting as applied to Welsbach burners (although considerable progress has been made towards improving the same), as compared with the lighting of electric lamps.

B. W. Perkins:—Cost, and likelihood of getting out of repair.

P. S. Young:—Because of the short life of the battery and their comparative high cost in comparison with matches.

Freeport Gas Light and Coke Company:—Because they are not reliable.

John Franklin:—The life of them is of too short a duration, and too easily gotten out of order.

J. J. Knight:—Because they are so unreliable, get out of order frequently, and require an endless amount of attention.

No. 204. Does it pay to push hot plates?

B. W. Perkins:—Hot plates are generally regarded as a makeshift cooking appliance. The sale of a range to a consumer is more likely to convince him that a gas range can permanently supplant any cooking appliance and do all of his cooking, whereas a hot plate gives him the idea that it is impossible to do all of his cooking on it.

P. S. Young:—Yes; if they are not pushed so as to affect the sale of ranges and more stable appliances.

E. M. Osborn:—Yes. Our experience is that hot plates, or fancy stoves, or new burners, or any other device by which people can be induced to use gas, pays.

Geo. Kirk:—No; better sell ranges.

Freeport Gas Light and Coke Company:—No.

John Franklin:—It pays to push energetically everything pertaining to the gas business.

E. Haase:—This question can be easily determined by those supplying gas to hot plates through a separate meter. It has been so determined by the one giving this answer, to the extent that the annual consumption of several hundred hot plate consumers has been compared with the average gas range consumer. In this comparison, the hot plates showed a record of 122,000 feet per annum, against 18,000 for gas ranges among a similar class of consumers. In the above comparison the gas range consumption mentioned is that of the first year's use of new gas ranges introduced. It is assumed that gas ranges make possible a development of the use of gas for purposes which the hot plate cannot. Baking, broiling and roasting on a gas range are probably not carried on to such an extent the first year as it is likely to develop into.

A hot plate might develop a gas range consumer sooner or later, but no doubt it puts off the introduction of the range some length of time.

Push the range.

EDITOR:—I think it is a mistake to push hot plates and I believe it pays to discourage their sale except for laundry purposes or where a range would be entirely out of place. If anybody cares to look up a paper I read at the 1898 convention of the American Gas Light Association, they will find the reasons set forth in detail why I oppose pushing hot plates. (*Progressive Age*, November 1, 1898.)

M. E. MALONE:—It is not advisable to push hot plates at any stage of the game, especially in a city where gas is first introduced for cooking purposes, for in many cases it precludes, or at lease postpones for a long time, the introduction of a gas range.

Hot plates are ordinarily only used as auxiliaries to wood or coal ranges in the summer time, hence, few and small gas bills. Hot plates cannot be used for baking or roasting without the use of a portable oven, which is neither economical nor satisfactory.

The inexperienced consumer, on receipt of the first large gas bill, will throw out the hot plate, owing to the small investment; this is not likely to occur when a gas range is installed—they will give it another trial.

Experience shows that you have to allow nearly the original cost of the hot plate when traded in for a gas range.

A gas range can now be purchased at such a low figure that it is within the reach of all.

Hot plates should only be recommended for laundries, restaurants and saloon lunch counters, and for industrial purposes, but should not be recommended for household cooking.

J. J. KNIGHT:—It pays to push hot plates, because they are good gas consumers; they also educate people to the use of gas, and are finally, almost invariably, followed by the purchase of a gas range.

No. 205. Is it better to push instantaneous water heaters or independent water heaters?

J. H. ENRIGHT:—We have never been able to discover how to increase our sales much by the pushing of instantaneous water

heaters. Of course we desire to put in use any appliance that will increase our sales; however, it is safe to state that one can sell more gas through one good vertical boiler heater than can be accomplished in several instantaneous heaters, and they do not cost over one-third the amount per heater.

B. W. PERKINS:—Instantaneous heaters are preferable for a bath room on the score of economy, speed and lesser likelihood of becoming clogged with lime deposits. Any number of people can use it for bathing purposes without the delay occasioned by the use of a circulating water heater.

P. S. YOUNG:—Independent water heaters in general; instantaneous water heaters only in particular cases.

GEO. KIRK:—Independent heaters are best.

THOMAS D. MILLER:—It is better to push instantaneous water heaters.

JOHN FRANKLIN:—Have no preference. Push whichever is the best to suit conditions; both if necessary.

C. J. FOX:—Instantaneous water heaters.

EDITOR:—I favor the independent water heater except under abnormal conditions. The instantaneous heater is often dangerous from explosion and from asphyxiation, due to the large quantity of combustion products thrown off. They cause an excessive demand, and as a rule are not particularly satisfactory, and do not yield very much consumption to the company.

W. B. TUTTLE:—We find that we have better success pushing independent water heaters than instantaneous water heaters. For small houses the independent water heater seems to be the best, that is, the cost is very much less and people who cannot afford to put in an instantaneous heater can put in an independent heater and, by using it only at such times as they require hot water, can avoid great expense. In large establishments where a good deal of water is required and where there is a considerable number of servants, the independent heater is almost always a source of complaint on account of the large bills, and in such places the instantaneous heater is the best.

ANONYMOUS:—Instantaneous water heaters have not attained the degree of perfection that should characterize them. If they provide a stream of hot water at a high temperature it is achieved by reduction in the quantity of water flowing from the heater. As constructed at present and the results attained by those instantaneous water heaters in the market, they intimate what ultimately

may be achieved in that direction. How are we going to transfer the heat units in gas through a medium like sheet metal into water and thereby raise the temperature of the latter to nearly boiling point is the proposition that confronts the maker of the instantaneous water heater. The methods pursued up to the present time in the construction of an instantaneous water heater have so far resulted in their being made, but at a price which makes their use practically prohibitive. When thoroughly investigated, you will find that the number of individuals who think they require hot water instantaneously and by means of an instantaneous gas heater, are comparatively few in number; and when they become acquainted with the price they will have to pay for such a heater their ardor in that direction seems to decrease very rapidly.

Independent water heaters are so constructed now, that they make a very near approach to being instantaneous; in fact, one heater might be so arranged as to act as an instantaneous water heater. Independent water heaters may be so manipulated that they will furnish all of the hot water required by a household in a satisfactory manner for all requirements, and much more economically than by using an instantaneous heater. It is manifest that water, once heated and held in a container, may be kept warm at a very slight expense in the shape of gas consumed.

In order to get the proper results in an instantaneous water heater there must necessarily be, according to their present construction, an extraordinarily large volume of gas consumed in the process of heating the water; therefore, in my opinion, it is much better and more satisfactory in every way, both to the gas company, and the gas consumer, to push the independent water heater.

No. 266. What form of gas heater is preferable to push for house-heating?

John Franklin:—I consider the open corrugated copper radiator the most serviceable and practical, provided they are kept polished and clean.

C. J. Fox:—Small round heaters.

Henry B. Leach:—The radiator has the preference in this locality.

Carl H. Graf:—Radiators and cylinder heaters, because they are neat, efficient, odorless, inexpensive and do not require a flue connection.

J. J. KNIGHT:—Small perforated sheet-iron stoves burning an illuminating flame.

GEO. WHYSALL:—The small portable drum heater usually sold with tubing and independent hose connection.

No. 207. Why do not instantaneous water heaters work efficiently at an altitude of 5,200 feet?

No. 209. What are the best materials and most desirable features or forms that should be embodied in an up-to-date gas range?

JOHN FRANKLIN:—Drilled burners, portable ovens, asbestos lined. Cast-iron range and wood lever handle cocks.

M. E. MALONE:—The best grade of cold rolled blue-planished steel should be used in the construction of the sides and back of a modern gas range. A high grade of open hearth sheet steel should be used for the inside linings, etc. The best quality of soft grey iron castings should be used for the top, front frame, legs and other parts where a good, strong casting with a smooth surface is required.

The oven of a gas range should be thoroughly insulated; it should be completely surrounded by two thicknesses of steel and a heavy wall of asbestos, and a dead air space outside the heat flue.

A special and important feature that should be embodied in the construction of a gas range is the removable top and oven burners. Removable oven linings should also be employed, so that any ordinary fitter can readily replace repair parts, thus avoiding the necessity and expense of returning the range to the factory for repairs.

A great deal depends upon the construction of the oven. The old style ovens were made like a box, with no ventilation. Heat passing through a thickness of iron, or radiated heat, is dry. A loaf of bread or cake baked in such an oven loses in weight and in value. The tendency of all the best manufacturers, for the last two or three years, has been toward "direct action" oven. One of the principal products of combustion is water, and it has been found that heated air, entering into the oven from the burners, that is moistened by the water of combustion, gives a much better

quality of baking than dry or radiated heat. Dough baked in such an oven loses one-half less weight than when baked in the old-style, air-tight oven.

By taking the heat from the burners directly into the oven, the temperature of the oven is raised to baking heat, with the least possible consumption of fuel. The modern oven can be heated to baking temperature with from 3.5 to 5 feet of gas, while the old style cast construction required from 18 to 24 feet of gas to reach the same temperature.

The drilled star-top burner is undoubtedly the most efficient. A great deal depends on the arrangement of the burner, and there is no doubt that the efficiency of many burners has been greatly increased by the proper location of same with reference to distance from bottom of cooking vessel, and the general condition under which burners were used.

Those who have made a study of burners, have found that sufficient air enters the mixer with the gas to support good combustion, that the success of the flame does not depend on easy access of fresh air to the stools of flame, but rather on the speed with which the products of combustion are taken away from the flame. In fact, the introduction of too much cold air directly into the flame cools, or rather retards combustion. The burners should be placed at such a distance that the article to be heated stands in the zone of purple light, and the conditions such that the products of combustion are taken away quickly, giving rapid combustion, which produces the greatest amount of heat. Top burners should be constructed in such form as to apply the heat nearer the center of the cooking vessel, thereby reducing to a minimum the cold center, forcing the heat to pass over the greatest possible area of the surface to be heated.

A water back in a gas range is a very undesirable feature as it tends to rapidly deteriorate the range.

GEO. WHYSALL:—Cast iron for top and front, planished steel for back and sides, with cast-iron oven floor, direct action with 16-inch oven and broiler, four top burners and simmering burner, and two oven burners..

No. 210.. English gas engines are considered by many engineers to be superior to American gas engines. Are they so as a matter of fact?

WALTER THOMAS:—With one or two exceptions, they are, which I have proven by six years' actual experience, using English engines exclusively and watching results of American engines in neighboring towns. One American town of 50,000 inhabitants has no engines running; a Canadian town on the same coast, 25,000 people, has 300 running profitably for the gas company and successfully for the consumer. The repair bill for the 30 engines did not average $5 each per year in the five years that they were put up against the most arduous work, some under trying conditions, running founderies, machine shops, sash and door factories, stone-sawing, wood-sawing, cold storage, electric light, etc., etc., successfully, competing and supplanting the cheapest electrical power on the Pacific coast. They are the result of 40 years' experience and experiment, are splendidly designed and proportioned to stand the work. No fickle electrical appliances are depended upon for the most vital part, *viz.*, the ignition. Great pains have been taken to put up a tube which operates successfully and economically. The valves are all positive, accurately proportioned. The proportion of air and gas is a known quantity; no taps to monkey with and try and get disgusted with. The engine will start when it is needed and a boy can start a 20-horse-power by hand.

O. B. KOHL, C. H. WILLIAMS:—To admit that they were, would be to admit that the English gas engineer is a superior of the American, which is not a fact. One thing which is misleaidng is a statement of the results obtained by the English built machines when operated on blast-furnace gas. The English engineers obtain some results which look remarkable to the American engineer at first glance, but an analysis will disclose the fact that Yankee ingenuity has so perfected the metal working machinery that the gas available at the American blast furnace has done its useful work, and is, consequently, but a lean product when compared with the partially used product of the English furnace.

No. 211. How should an incandescent gas burner be constructed?

E. M. OSBORN:—Like the Kern burner. We think this burner is a perfect type of incandescent gas burner.

JOHN FRANKLIN:—Cone-shaped with flaring mouth-piece, open and non-adjustable air ports, double air chamber for carrying

extra supply of air to upper mixing chamber, producing a most powerful flame that can be had by uniting air and gas through automatic suction and continuous draft movement, insuring at all times perfect combustion. The flame produced creates in an incandescent mantle what is known as a hyper-incandescence, which, by the construction of the burner, is continuous to the extreme tip of the mantle.

The flame is cone-shaped, elongated and intensely bluish hue, a pure hydro-carbon mixture.

A. H. Humphrey:—The best form of an individual incandescent gas burner has not yet been produced. It will be chimneyless, the mantle will be somewhat smaller than generally in use at present, and when lighted will be completely incandescent, and will not carbonize. The burner will not light back, and it will work perfectly on any kind of gas at 25-tenths pressure, or 10 to 15-tenths variation either way, from that pressure, without readjustment.

No. 212. What plans have been adopted to use gas heaters without vitiating the air of rooms? What are the complaints most frequently received?

George MacMillan:—Out of about 150 in use we have had no complaints.

Editor:—This problem has not been solved, and apparently no effort is being made on the part of appliance companies to solve it. It would be entirely possible to conduct the products of combustion from the room without losing to exceed one-fifth the heat of the gas, and in some places not to exceed one-tenth. In other words, heating stoves could be built which would have an efficiency of 80 or 90 per cent. without discharging the products of combustion in the room. No great progress in house-heating will result until we have heaters very different from those in present use. I believe that form of heater will eventually prove the most successful which discharges the products of combustion outside the room and which delivers the largest percentage of its heat in the form of radiant heat.

J. J. Knight:—Rooms properly constructed for living purposes require no other plans. Complaints are from odor caused by partly clogged burners, from which gas escapes without burning, and from defective burners which cause flame to impinge on some part of the stove and generate lampblack and odor.

No. 251. What is the advisability of pushing street lighting by means of incandescent gas burners and the best method of so doing?

J. H. Enright:—Where there is a reasonable chance to secure street lighting, I believe the best introduction would be to ask of the city government to erect, say, four good incandescent gas lamps per block (say, for three or four blocks), on some prominent street or thoroughfare, and maintain them in A-1 style, free of cost to the city for limited time, inviting public inspection for the service before making a proposition to the city government.

City councils, as well as the people, like object lessons.

Freeport Gas Light and Coke Company:—Do not do it.

John Franklin:—Same energy required as any other part of business providing you can reap the benefit financially. Get your ordinance first, then arrange for location of posts and lanterns. Regarding the method of so doing depends entirely upon conditions.

A. H. Humphrey:—Street lighting by gas will soon be the subject uppermost in the minds of gas men. It will be done with gas under high pressure, supplied through independent mains of small size, arranged to light and extinguish from a central point. A display plant of this kind will be in operation in Kalamazoo, Mich., within a few months.

No. 252. What plan should be followed, and to what extent should gas companies go, in piping houses, both old and new?

P. S. Young:—In towns where all new houses are piped for gas as they are built, companies should confine themselves to piping old houses. Where it is the exception for new houses to be piped, the local company should pipe both new and old houses. Company should live religiously up to its own piping regulations.

Mastin Simpson:—I believe that the companies will do well to leave out, with the exception of stove runs, the piping of all houses. Such throws an endless responsibility on the company, both regarding the original work and possible damage to property, but also on the future maintenance and ultimate responsibility due to defects, settling, changes, time, etc.

Geo. Kirk:—Leave house piping for plumbers.

John Franklin:—Personally I do not favor gas companies doing interior pipe fitting. Leave that part of it to the gasfitters.

E. HAASE:—The development of any existing part of our gas equipment to further productiveness is a matter of first consideration. It pays better to go after an illuminating consumer, who is already using gas for fuel purposes, than it would to go after the same class of a consumer for illuminating purposes who has not already a service pipe leading into his house. Through the rapid introduction of gas ranges no doubt the companies generally have added to their books consumers for fuel purposes a large proportion of whose houses are not piped for illuminating gas. Owing to this fact, they will be slow to develop into users of gas for illuminating purposes, unless some inducement is made them, or some plan is devised by which their houses can be piped. The fear that they will damage the house by having it piped often keeps people from entertaining the idea. It seems it would pay to see that they can get them to use gas for illuminating purposes rather than to wait until some time in the future for them to develop. With an expense equaling the profit on the gas they will use during the first year for illuminating purposes, a great deal can be accomplished in the way of getting their business rapidly. Piping these houses free and letting the owner pay for the fixtures at regular retail prices has proven a very effective offer. All of the above, of course, refers to old houses. New houses should not be piped by the gas company. A refusal to do so ought to result in them being piped under the building contracts.

HENRY B. LEACH:—It has been our practice, for the past 20 years, to pipe houses, new or old, at cost, also gas fixtures, and run a service free, as the cheaper we can fit a house for gas consumption, the more liable they are to come into the fold.

J. J. KNIGHT:—They should pipe, or supervise the piping, both of old houses and every other building in the city that is not piped. They should use large pipe and maintain its size wherever it goes, except in the drops. They should try to get cost for doing the work, and if any loss it should be on the fixtures.

No. 253. Can the waste heat from coal-gas benches be utilized to establish a district heating plant?

No. 254. How can gas business be cultivated between 1:00 o'clock A. M. and 5:00 o'clock A. M.?

P. S. YOUNG:—Chief business to be obtained between 1:00 o'clock A. M. and 5:00 A. M. would be street lighting, all night restaurants, watch lights, hall lights, newspaper offices and their appliances (linotype machines, matrix dryers, etc.)

GEORGE KIRK:—Have the questioner come to California.

JOHN FRANKLIN:—Get street lighting.

J. J. KNIGHT:—In street lighting, which is surely coming back to us.

No. 255. Where gas companies sell cooking ranges to consumers at a uniform price of $10, for instance, what is the estimated average direct loss to it per range when including difference between purchase and selling price of the range, free connections, cartage, store expense, clerk hire, advertising, insurance, depreciation, interest on investment, solicitors commission, inspection, etc., within a period of one year after a range is sold?

J. J. KNIGHT:—A gas company can certainly well afford to lose all the profit on the gas used in a cook stove the first year after its installation, and on an average that will not be less than the items mentioned, if the stove is sold at cost. It would scarcely be proper to sell all stoves at $10.

No. 256. Why do gas companies allow so much industrial gas business to slip away from them?

J. J. KNIGHT:—I do not believe that gas companies that are up-to-date, and are alive to the importance of new business are letting anything slip away from them that there is any money in.

No. 257. Can any member state any factories using gas for welding steel or iron, and give their address?

E. C. CRITCHLOW:—The Shadbolt and Boyd Iron Company, of Milwaukee, are using the Acme gas process (carbureted air) to weld iron.

F. W. STONE:—The Ashtabula Tool Company some time ago used coal-gas for welding steel, and at the present time are using natural gas for the same purpose. In spite of the fact that some gas engineers claim that a good weld cannot be made on steel with coal-gas, owing to the rapid oxidization of the surface of the metal, these people have found no difficulty.

No. 351. What type of coke crusher produces the least breeze?

No. 352. Does it pay to crush coke?

T. R. BEAL:—In this section of the country (New York) it decidedly does not pay to crush coke owing to the waste that results. Better let the customer stand the loss if he wants it crushed by crushing it himself.

FREEPORT GAS LIGHT AND COKE COMPANY:—No.

F. W. STONE:—It pays to crush coke wherever the market demands it and will pay an extra price to cover cost of crushing and loss by breeze. At a small works this charge should not be less than $1 per ton. A man will crush from 6 to 8 tons per day and the loss by breeze will be from 10 per cent. to 20 per cent., according to the quality of the coke crushed. At one of our works 80 per cent. of our coke is sold crushed, there being practically no market for uncrushed coke. At another, 60 per cent. Where there is a light demand for coke of a small size, a screen seems to be more economical than a crusher. The labor and power required is no more, and there is less waste to the coke. With a revolving screen 3 feet in diameter and 16 feet long, consisting of 5 feet of 0.5-inch wire mesh, 6 feet of 1.75-inch wire mesh, and 5 feet of 2.5-inch wire mesh, screen set with an incline of 1 inch in 12 inches, results averaged, per 1,000 pounds coke: 50 pounds breeze, 280 pounds through the 1.75-inch screen, 315 pounds through the 2.5-inch screen. Balance went through as uncrushed. The results varied greatly, some kinds of coal making a great deal more fine coke than others. The degree of hardness to which the coke is burned also affects the amount of breeze.

HENRY B. LEACH:—We should say yes, if you cannot sell it without, but as we have already sale for our product we do not crush.

J. J. KNIGHT:—It does not pay to crush coke.

ERNEST F. LLOYD:—We do not crush coke, but separate the small size by dumping it over a screen which produces sufficient for our requirements.

No. 353. What kind of coke screen is in most general use? What is comparative cost and desirability of revolving and shaking screens?

T. R. BEAL:—Both shaking and revolving screens are undesirable, as they produce too much breakage. A screen is made of punched sheets having parallel bars which are stepped about every

12 inches. Coke flowing gently over about 48 inches of this screen at the proper angle is well screened, with no breakage.

EDITOR:—I have had very good results from the use of shaking screens. The cost of a shaking screen is generally less and requires less power for its operation. If two sizes of coke only are desired, two screens are used lagging each other in reciprocation by 90 degrees. Where three sizes of coke are desired, the screens are operated from the same crank, the reciprocating motion for each screen being 120 degrees behind the preceding one. Such a screen can easily be made in any gas-works and can be operated more conveniently with an electric motor than otherwise. The screen can be made portable if desired and put on wheels.

J. J. KNIGHT:—Coke should not be screened; that is, if the consumer's interests are considered, and it is sold by the bushel. It is well to grade it into two sizes.

No. 354. How may an ammonia market be cultivated?

No. 401. How shall we determine the profitable extension of gas mains into new territory?

P. S. YOUNG:—By knowledge of business obtained in like localities elsewhere, style of houses, character of occupants, etc.; not by canvass, for a long delay would injure results.

R. C. ALLEN:—The most satisfactory way to determine whether a proposed extension will be profitable is to make a thorough canvass of the district to be covered and ascertain the exact number of customers that can be acquired, getting from each a signed contract. An estimate can be made of the probable revenue from these customers and, knowing the cost of the extension, its advisability can easily be determined.

GEO. KIRK:—By requiring one new consumer to each 100 feet of main.

FREEPORT GAS LIGHT AND COKE COMPANY:—The number of residents and class of people, as well as prospects for additional building.

JOHN FRANKLIN:—By solicitation, after which obtain cost of necessary extension; compare the estimate receipts with the probable outlay. If a fair return, extend your mains.

EDITOR:—A thorough answer to this question would comprise a whole volume. Separation between cost proportional to output, cost proportional to consumers, and cost of additional feeder mains based on distance from works, must be determined. It is customary for most gas companies to allow 100 feet of main for each consumer regardless of how large or how small this consumer may be and regardless of what profit may be per 1,000 cubic feet. From some recent calculations made by a large gas company, they could afford to lay 300 feet of main for each consumer, assuming that these consumers were to be as heavy users as the consumers taken on through the previous two years.

HENRY B. LEACH:—We require a guarantee for five years, that the parties will use gas to the amount of $5 per year, for each 100 feet of main laid, and find, that such an arrangement is profitable.

C. O. G. MILLER:—This company has made it a rule for many years to lay as much as 400 feet of main for one consumer in a territory that gives promise of growing and we have never regretted so doing, on the supposition that the lots would fill up finally. It is a question of how many years' interest you are willing to lose, also if you encourage building by having your supply ready.

F. W. BLOWERS:—We believe gas mains can be extended profitably into new territory, providing new consumers sufficient to average one every 100 feet of gas main so extended, can be obtained.

No. 402. How far should a gas company go to correct errors in piping, burners and appliances beyond the meter?

P. S. YOUNG:—Far enough to correct them.

MASTIN SIMPSON:—The value of favorable public opinion cannot be overestimated in the gas business, hence a liberal policy will bring a profitable business. I think that the answer of this question can be covered in the following: "Do all you can to create an efficient service until such work places you in a position where you may be responsible either at the time or in the future for work done by others." You will see that I make quite a strong point of this matter of responsibility, but all through my experience in the gas business I have found the company being

held responsible for whole systems of piping, which were inefficient, because the company had made some minor change in their system at some time.

GEO. KIRK:—Only to locate the trouble.

FREEPORT GAS LIGHT AND COKE COMPANY:—The prospective gas consumption should determine.

JOHN FRANKLIN:—As stated before, arrange that part of it for the gasfitter to attend to.

C. J. FOX:—To the burner.

HENRY B. LEACH:—Our rules require that pipers must use pipe according to our schedule, which if not adhered to, no meter will be set in the building. Of course, it is inspected by an employe of the company, who also sees that it stands the proper test.

J. J. KNIGHT:—To the limit necessary to correct them.

No. 403. What is the best plan to systematically locate defective service or appliances?

JOHN FRANKLIN:—Test air at a pressure of 10 pounds.

CARL H. GRAF:—Send inspector around and also invite complaints.

J. J. KNIGHT:—House to house canvass at least annually by intelligent, well-schooled men.

No. 404. What is the most desirable candle-power to serve?

GEO. KIRK:—Coal-gas, 18 candle-power. Oil-gas, 20 to 22 candle-power.

FREEPORT GAS LIGHT AND COKE COMPANY:—Eighteen candle-power with coal-gas.

JOHN FRANKLIN:—From 16 to 17 candle-power.

WM. H. COOPER:—If water-gas is used, 24 candle-power; if coal-gas, 17 candle-power; if half water and half coal-gas, then 22 candle-power.

No. 405. Are gas meter rents desirable, and on what basis should rent be charged?

GEO. KIRK:—Gas meter rents are undesirable.

FREEPORT GAS LIGHT AND COKE COMPANY:—No.

J. J. KNIGHT:—Meter rent is not desirable because it is unpopular. Minimum bills should be allowed by ordinance and generally City Council will object to this. Meters should record the 10's of cubic feet.

No. 406. Does the enforced signing of a contract for gas retard the development of business, and if so, to what extent?

P. S. YOUNG:—If by contract is meant application, no. If it means an agreement to burn a certain amount of gas, in my judgment, yes. To what extent, I cannot say, but to an appreciable extent.

GEO. KIRK:—Singing of contract does not retard the development of our business.

FREEPORT GAS LIGHT AND COKE COMPANY:—No.

No. 407. Why do we make our consumers come to our office to pay their bills when others do not? What are its desirable features other than saving expenses?

F. W. KELLEY:—It is desirable for gas companies to have store buildings located in the business center of the city for offices, and to have them completely furnished with samples of gas appliances, particularly a good display of appliances for fuel purposes. Under these conditions it is an easy matter to increase your output by interesting your consumers in appliances which they are not using.

B. W. PERKINS:—The desirable features of a gas consumer paying his bill at the office of the gas company are: That he can time his visit for his own convenience as to paying better than a collector could in calling upon him; that in calling at the office of the company he can see an exhibit of gas appliances that he would not without such visits; that he gets in touch with more of the company's officials, sees their methods of doing business, etc.

FREEPORT GAS LIGHT AND COKE COMPANY:—The close financier will call at the office to save the discount, otherwise he will stand you off two or three months and have the use of his money.

JOHN FRANKLIN:—In our city we have stations where our patrons can pay bills, this lessens the labor of our receiving department. The American Express Company takes up the collection, charging the consumer five cents for each bill collected.

C. J. Fox:—To become better acquainted with the management; also inspect the different gas appliances.

S. J. Glass:—Prior to January 1, 1903, we had a contract with the American Express Company for the collection of gas bills through their various branch agencies in the city, which numbered about 125. They collected in the month of December, approximately, 7,500 bills, aggregating $16,000. January 1, we inaugurated our system of gas company pay stations, and during the month of January collected 20,200 bills, aggregating $46,-017.64. During the month of February we collected 22,212 bills, aggregating $51,269.61. The total number of bills rendered during each of the three months mentioned above approximated 39,000.

Under the old arrangement the consumer paid the customary money order fee of five cents upwards, according to the amount of the bill, in addition to the amount called for by the bill itself. Under the new arrangement the gas company pays to each of the pay station agencies a fee of one-half cent for each bill collected, regardless of the amount of same. The agents are very enthusiastic over the change and feel that it has been an exceedingly profitable change to them.

We are very well satisfied with the results so far, as it has greatly relieved the congestion in our office on the last days of discount, and what is more to the point, meets the approval of our customers by making it convenient for them to pay their bills without going far from their homes or places of business, and without any additional expense whatever. We certainly feel that we are warranted in standing the expense of the sub-collection agencies on account of the relief from congestion and on account of the advantage to our customers.

No. 408. Are gas companies warranted in standing expenses of sub-collection agencies?

S. J. Glass:—See answer to No. 407.

John Franklin:—See answer to No. 407.

J. J. Knight:—Gas companies should have no sub-station agencies. In cities of over 100,000 inhabitants they should maintain district offices, where bills can be paid, complaints made, and appliances shown and sold.

No. 409. Is it not desirable to read meters and collect bills at more than one period in the month?

IRVIN BUTTERWORTH:—Yes, at least in cities and towns of the larger size. It permits the employment of fewer meter readers, who therefore become very skillful both in reading meters with a minimum of errors and in familiarizing themselves with the location of the meters on their routes; and it relieves the office of its periodical monthly congestion and rush of work, enabling the office force to give better and more satisfactory attention to the company's consumers.

GEO. KIRK:—It is desirable to have meters read at various times during the month.

JOHN FRANKLIN:—Desirable in case of large consumers.

C. J. FOX:—No.

No. 410. Should the same man read both gas and electric meters?

IRVIN BUTTERWORTH:—Yes, by all means, for the sake of economy and to reduce to a minimum the annoyance to consumers from meter-readers' visits.

GEO. KIRK:—Certainly, especially where both gas and electric are in same premises.

T. R. BEAL:—No. Where there are two departments it is found desirable to let each stand on its own merits and have separate force of employes as far as possible.

JOHN FRANKLIN:—Depends upon conditions.

No. 411. Should meter readers and other similar employes be uniformed?

GEO. KIRK:—Not necessarily.

JOHN FRANKLIN:—Uniform, cap and badge.

J. J. KNIGHT:—Meter readers should be uniformed.

CARL H. GRAF:—It is not very desirable to uniform meter readers and other similar employes, the objection being that the work they are at times called upon to do makes it difficult to keep the uniform neat and clean.

B. H. PETLEY:—Meter employes and other similar employes should be provided with identification cards, signed by an officer of the company, and all consumers should be notified that such provision has been made.

No. 412. Is profit-sharing with employes desirable? What results have followed its adoption?

Irvin Butterworth:—I think profit-sharing by a gas company with its employes is desirable, if for no other reason than that it raises the wages of its most faithful employes in a way that incidentally does the company the most good, by inculcating in the minds of the community an impression of the company's fairness, liberality and progressiveness. In the cities where it has been tried, I believe that this has been the most important result that has followed its adoption, the direct benefits to the employes themselves, or to the company from increased interest in its welfare on the part of its employes, being disappointingly slight.

F. W. Stone:—Yes; men take an interest. Get better men, and if the arrangement is such that it depends on continued service, the better men stay longer.

No. 414. Is it desirable to keep the office open evenings?

F. W. Kelley:—Where companies require their consumers to pay bills at the office, it is desirable to keep the office open evenings, as a large percentage of the consumers cannot conveniently arrange to call during the day. The writer's experience is that more gas appliances, especially water heaters and gas ranges, are sold in the evenings than during the day.

B. W. Perkins:—Our experience shows that it is desirable to keep open evenings a portion of the month, as many will visit the office who are occupied during the day.

V. L. Elbert:—Yes.

C. O. G. Miller:—We believe it desirable to keep our office open in the evenings, we have always one man looking after the pressure and one or two men ready to attend to any work required for any cause by the consumers.

No. 415. Why do gas companies have all the small consumers and the electric companies the large ones?

V. L. Elbert:—There is no reason, with the lighting appliances that are at hand these days, for any such state of affairs in any gas company not operating an electric light plant.

Geo. Kirk:—We have them both.

Freeport Gas Light and Coke Company:—They do not in Freeport.

John Franklin:—In large institutions it is more convenient to have electric light even though the expense is greater—pay your money and take your choice.

C. O. G. Miller:—The gas companies do not have all the small consumers and the electric companies all the large ones in this city.

A. H. Humphrey:—This condition does not exist at all where gas companies are active in looking after the lighting business, and need not exist in any case. There are many cities where the reverse of the condition stated is true, also many cities where gas companies having an electric department, are pushing "gas arc lamps."

No. 416. What special policy should be outlined for a combined gas and electric company?

Irvin Butterworth:—This is a much more difficult question to answer than would at first appear. In a general way, I would say study carefully the costs entering into the various branches of your service, make an exact analysis of them and so ascertain what each class of service costs you. Then consider in connection with these costs the prices received, or which could be obtained from each branch of the service, and push those that promise from these considerations the greatest amount of net earnings. This is easier said than done! Ordinarily, and except under exceptional circumstances, I believe that a combined comany can now make more money by lighting the city's streets with gas instead of electricity; by cultivating the use of motors for short-hour service or variable loads, and gas engines for long-hour service at full loads; and other things being equal, by cultivating the use of gas engines near the gas-works and of motors near the electric station, when the two are remote from each other. In making extensions into new territory the gas distribution system should ordinarily be introduced first, postponing the extension of the electric distribution system as long as possible.

T. R. Beal:—The two departments should be run as separate companies, and each worked against the other in competition for all new business. Existing business should be carefully guarded by its department, so as to avoid the desire on the part of the customer to change, and this can only be accomplished by good service stimulating both departments to best efforts.

J. J. Knight:—The special policy for such companies, and a policy important above all others, should be to see to it, that their consumers are given the opportunity to avail themselves of the latest and best appliances for the use of either gas or electricity, and on as favorable terms as are given where the combination does not exist.

No. 417. Are differential rates advisable, and on what basis should differential prices be made?

Geo. Kirk:—Differential rates are advisable.

J. J. Knight:—Differential rates are desirable. Rates should differentiate on 2,000, 5,000 and 10,000 or over consumption, and no greater charge to be made for a less amount of gas.

C. O. G. Miller:—I believe the consumer using from 100,000 to 200,000 feet of gas per month for manufacturing purposes near the center of consumption or in a factory district should receive a much lower rate than a consumer using from 1,000 to 1,500 feet per month a long distance from the place of manufacture.

Ernest F. Lloyd:—I certainly consider differential rates to be advisable and that without other considerations applying, the price of each should be fixed by competition in its own field.

No. 418. How do taxes of gas companies compare with taxes of other corporations?

Freeport Gas Light and Coke Company:—About 60 per cent. higher in Freeport.

J. J. Knight:—As a rule, my observation is that they compare equitably.

No. 419. What is a fair rate to pay for taxes per 1,000 feet sold?

J. J. Knight:—Gas companies should be known as liberal tax-payers, not tax fighters. My observation and experience, covering a number of years and quite a large number of cities, would seem to indicate that about 1 per cent. of the actual cash value of all property is about the average for all taxes collected per annum; that at this rate taxes are paid without complaint, and for the most part all are willing to pay their fair share; that where the

amount of all taxes are less than this rate, the taxes are considered low, and where they exceed this very much they become burdensome.

I think it will be found that $4,000 per 1,000,000 cubic feet of gas sold is a fair average basis for estimating the actual worth of gas properties. This does not include prospective worth, which should not be taxed, and this would indicate that about 4 cents per 1,000 cubic feet of gas sold is a fair rate of taxation as compared with other property.

No. 420. To what extent should we encourage schools, colleges or corresondence schools in providing gas engineering courses?

V. L. Elbert:—Only to the extent of the text-book education. The practical part can be better obtained with the gas company. My reasons are that there are so few gas companies in the United States that a great many disappointments are liable to occur to students in not obtaining positions they have best fitted themselves for, and the opportunities are few.

T. R. Beal:—Every encouragement should be given. We all know how difficult it is to secure men fitted for any branch of the business, and should be willing to assist in the education of those who are ambitious to learn, as it will surely result in great benefit to the industry at large, if not always for our personal benefit. Also we all know how difficult a technical education is to acquire without proper and systematic guidance.

Freeport Gas Light and Coke Company:—To the fullest extent.

No. 421. Is it good policy on the part of a gas company making free connections for its patrons, to limit such free connections to gas appliances only as are manufactured in its own home city?

Mastin Simpson:—I should say most certainly not. The free service is a great feature. Its object is that of profit to the company. The company generally had a hard enough fight under the usual conditions without trying to pull through all the minor manufacturing establishments of the city in which it operates.

Freeport Gas Light and Coke Company:—No.

C. O. G. MILLER:—I think it is not good policy on the part of gas company making free connections for its patrons, to limit such free connections to gas appliances only as are manufactured in its own home city.

No. 422. Who has tried profit-sharing with employes and with what success? What are the objections to inaugurating such a system?

MASTIN SIMPSON:—I do not believe in profit-sharing for employes, although I have never tried such a plan with them and would not enter into an agreement that would obligate the company in its position towards the men that did not on the other hand obligate the men to the company for misconduct, carelessness, etc. I have yet to find a class of men who live up to their obligations in the same manner that they exact from the company.

No. 423. Is it more desirable and profitable to sell gas for one price for fuel and light, where consumption for same is about equal, than to establish differential rates?

FREEPORT GAS LIGHT AND COKE COMPANY:—One price only.

GEO. MACMILLAN.—More expensive, but more desirable to establish two meters and two prices.

C. O. G. MILLER:—I think it somewhat desirable to sell gas for a uniform price for light and fuel where the consumption is about equal.

No. 425. Has any company supplying, say, 6,000 consumers, tried the continuous meter-reading system? What success have they had?

GEO. MACMILLAN:—Our company was doing this with our electric meters, but has discontinued it.

No. 426. Is it the desire of gas companies as a whole to adopt a straight reading meter-dial, if a reliable one can be furnished at a reasonable cost?

No. 451. What is your per capita consumption? What per cent. is lighting and what heating? What is ratio of increase in last decade?

B. W. Perkins:—Our consumption is 2,460 feet per capita, 45 per cent. for lighting, 55 per cent. for fuel. The percentage of increase over the year previous is 24 per cent.

No. 452. Did you ever know of a gas holder being exploded by being struck by lightning?

B. W. Perkins:—No.

V. L. Elbert:—No.

E. M. Osborn:—No. We think such a thing would be impossible. If such a thing were to happen, though we doubt it could, as we have never heard of it in our experience, the iron in the tank forming a good conductor, as well as a large one, would carry off the current of electric fluid sufficiently rapid to avoid any danger from the strike.

Geo. Kirk:—No lightning in California.

Freeport Gas Light and Coke Company:—No.

Alfred E. Forstall:—Reference, A. G. L. A. Proceedings, Vol. 18, page 234.

C. J. Fox:—No.

No. 453. Why do some contractors, in building large purifier covers, where a water-seal is used, build the tops rounding instead of flat?

Henry G. Morris:—The practice of making the tops of purifiers curved instead of flat is owing to the desirability of preventing leakage of rivited joints, which would be liable to be caused by the change of form due to the pressure of gas, as well as to make a rigid structure which would bear lifting from four points without unnecessary distortion.

B. H. Petley:—I believe that it is better to build the tops of purifier covers rounding instead of flat because a greater degree of stiffness is thus obtained at slightly increased cost.

Geo. MacMillan:—Probably for stiffening and securing more room from oxide. Tried both and have found little or no difference in practice.

Ernest F. Lloyd:—The building of covers with rounded or flat tops is in common practice largely a matter of taste. From the engineering standpoint, however, covers should be rounded or flat according to the method in which the engineer resolves the

pressure. If the stiffening member is to be regarded as a beam, it should be straight or flat: if the pressures are to resolve into a tensile strain, it should be curved, but in such case to take advantage of the lesser section of material thereby required, the ends should be secured from drawing together in brackets. This is not generally done, hence the curved beam is weaker than the flat. Properly constructed, the flat beam relieves the sides of the boxes of any strain and less gas is lost in removing the covers.

No. 454. Should there not be a universal rule as to the direction in which gate valves should be turned in order to open and close them? In other words, should not such valves be made to close when turned to the right, as is the case with steam valves?

Mastin Simpson:—I believe it is generally acknowledged that all the valves in the gas system should operate in one direction to avoid against accident, so that a test will prove whether a valve is open or shut by a simple turning of the same. It had never occurred to me before, but it now appeals to me to have all the valves work one way, say gas to the left and all the steam valves operate the other way. If any question should arise as to the valve a simple twist of the hand would indicate whether it is a steam or gas valve.

Geo. Kirk:—There should be a uniform rule.

Freeport Gas Light and Coke Company:—Yes.

B. H. Petley:—I believe that we are all united on the opinion that all gas valves should be made to operate the same, closing by turning to either the right or left. My individual opinion is that they should close by turning to the right, as is most common with all other valves and is most generally known.

Geo. MacMillan:—Yes.

Frank Helen:—There should be a universal rule as regards the opening and closing of all valves. I believe all valves should turn to the right to close. If this is not true of all valves in use it will be necessary to refer to office records to determine which way to turn each particular valve. Occasions will arise when valves should be opened or closed immediately, and records will not be available for instant use. I refer particularly to valves in the grounds. We have many such valves on our natural gas system, and I have known confusion and consequent delay resulting from inability to determine whether the valve was a right hand valve or a left hand valve.

Ernest F. Lloyd:—Valves should unquestionably all close by turning to the right, excepting in works where the left-closing valve has been originally adopted, and where the confusion of changing would be worse than to continue having them all wrong. The best reason which I have so far seen advanced for the left-closing valve is the opinion of a very prominent manufacturer, appended:

"In regard to the way valves open, *all* valves open to the left except bell and water valves. Just why this particular form of valve, which is usually placed 5 or 6 feet underground, should open contrary to other valves which are above ground and in plain sight, is one of those mysteries which has never been explained. If you should order bell and gas valves, we should not think to ask which way they opened, for they, like the flanged valves, open to the left."

No. 455. Why not build rectangular holders and tanks (when using steel tanks) instead of round ones, for the sake of economy of ground space?

Henry G. Morris:—It is only necessary to say, in answer to this question, that a rectangular tank is not a stable form, as is the case of the circular one.

Geo. MacMillan:—The rectangular form will economize ground space, no doubt, but it would probably increase cost of holder construction more than difference.

Ernest F. Lloyd:—A circular holder is self-contained, a rectangular one is not, and the inconvenience and cost of bracing it would greatly exceed the value of the ground space saved.

No. 456. What are the relative measurements as regards water and mercury in pressure gage?

B. H. Petley:—The specific gravity of mercury is 13.596 times the specific gravity of water; therefore knowing the pressure in inches of mercury, the corresponding pressure in inches of water can readily be determined by multiplying by 13.596.

No. 457. What is meant by "tenths" and "ounces," also what basis is taken to arrive at these pressures, on any U-pressure gage, such as the "Thorpe?"

W. H. BARTHOLD:—This is probably understood by everybody, but will say that a pound of pressure will raise the water in a U-gage 27.77 inches. An ounce of pressure, one-sixteenth of this, or about 1.74 inches.

B. H. PETLEY:—One-tenth inch of pressure as shown by the U-gage, is the pressure applied to the surface of water on one side of the U-tube in order to raise the water in the other side one-tenth of an inch; 27.7 cubic inches of water weigh 1 pound, or a column of water with area equal to 1 square inch and 27.7 inches high is equivalent to 1 pound. One ounce, then, would be one-sixteenth of 27.7 inches, or 1.73 inches of water.

No. 458. What are the advantages of two-stage compression in Pintsch plants?

J. A. DIXON:—The only advantages we have ever obtained from two-stage compression of gas is, where large amounts of gas are to be compressed it gives an economy of floor space and reduces the investment in compressors.

SECOND DAY.—MORNING SESSION.

The Association met at 9:30 A. M.

THE PRESIDENT:—Gentlemen, the first paper on the program this morning is "Domestic Heating by Gas," by Donald McDonald.

DONALD MCDONALD:—I think it is only due respect to the Association for me to say that I did not prepare this article as a paper, but merely as a forecast of what my remarks would be in a general discussion of this subject. I say that because I have not attempted to cover the subject, but only to cover a very small part of it and I expected that others who would succeed me would cover it more thoroughly.

DOMESTIC HEATING BY GAS.

DONALD M'DONALD.

The sale of gas for domestic heating opens up a field which if worked with great energy and without great discretion, will overtax the plant of any gas company for a few days in the year, and will result in very little income for the rest of the year. It will also result in such dissatisfaction on the part of the consumers

that the business gained will soon be lost. On the other hand, if the field is worked with thoughtfulness and discretion it will prove a very profitable one, and the ultimate sales will be larger than those which are made for illuminating purposes in the same city. The first thing to be considered is the price.

The price must be made low enough not to compete with coal, but to allow the gas to be used in those places where coal will not do nearly as well. In my own opinion 60 cents per 1,000 cubic feet for a good, clean gas of 650 heat units is about the top limit. If the price can be made lower, the sales will be very much larger.

The next most important point is the use to which the gas is to be put by the consumer. It is the poorest sort of policy for a gas company to encourage the people to attempt to use the gas for purposes for which it will not answer. It must result in great dissatisfaction and distrust on the part of the consumer, and after paying a few large bills all such uses are sure to be abandoned. No gas company wants the whole of the heating of any house. What you do want is the mild weather heating—fires which will be used in the spring and fall and will be lighted rarely, if at all, during the winter. If the people are correctly informed from the beginning the price of the gas will itself take care of this matter. Gas at 60 cents, or even at 50 cents, is much too expensive for a constant fire. It is, however, quite economical and quite convenient when it is used in a house where the principal heat is derived from a furnace, and where the gas is only used as a supplement to the furnace, or when the weather is too warm to have the furnace lighted. This sort of use will result in an almost steady demand from 7 o'clock in the morning until 9:30 at night. There is likely to be enough places where gas is the only heat and which will burn large amounts in very cold weather to make up for those places in which the use of gas is abandoned entirely when the weather is cold enough to light the furnace.

A gas fire in a dining-room is a very desirable one. It is sure to be lighted three times a day, and being used only at meal hours, the cost is not more than consumers are willing to pay. Where there are no furnaces in the houses a great deal of gas can be sold by encouraging persons to do their principal heating with an anthracite stove, and their local, supplementary and warm weather heating with gas. In the humbler class of houses a good trade can be worked up by arranging to place gas stoves in the same

rooms where there are coal fires or other means of heating. Many days will come when it is not convenient to use the coal fire and when the gas stove will be lighted. On the other hand, when the weather is steadily cold and the company probably needs gas even more than it needs money, these stoves are not likely to be lighted at all.

The next most important question is the fixtures in which the gas is to be burned. Where the heating is temporary and supplemental, an open front stove without a flue is the best. The flame is able to take all the air that it needs, the combustion ought to be complete, and nothing will be produced except carbonic acid and water. The ventilation of the other fires will easily carry these away. If gas radiators or other closed heaters are used the openings which supply air are apt to become closed up, the combustion becomes smothered and hence incomplete, and the result is carbonic oxide, acrolene, and many other substances for which the chemists have learned names, but for which common people use the only short word, "stink."

Where the gas is the only source of heat and the room is occupied as a bed chamber, it is much better, although somewhat more expensive, to use a closed heater provided with a good flue. Such a heat must, however, meet many very rigid conditions, otherwise the flue connection will be worse than useless. First of all the flue must be so open and must run so high that a down draft through it will be an impossibility. A few seconds of down draft, carrying with it a load of carbonic acid and nitrogen, will put out the fire, and the flue becoming cold, the down draft will continue and the apartment become full of gas. No flue at all is much better than this. The stove must also be so constructed that no more air is drawn through it than is necessary to burn the gas, otherwise there will be a great waste of heat up the chimney.

The amount of air required to burn the gas, if it is cooled to 300 degrees before it reaches the chimney, will only carry away with it about 5 per cent. of the heat. Closed stoves, however, as generally constructed, send up the chimney anywhere from 20 per cent. to 80 per cent. of the heat produced by the gas. Any device which sends a part of the products of combustion up the chimney and the rest of it into the room is simple folly. The part which reaches the chimney is no better and no worse than the part which is put into the room, and unless care is taken to send *all* of the products of combustion up the chimney it is much more sensible not to send any of them.

I have seen and heard many learned discussions as to the question of whether a luminous flame or a blue flame produces the most heat. Nearly all salesmen and dealers of gas stoves will insist that the particular burner which they are advocating produces a great deal more heat than any other burner. Of course, any chemist or any engineer knows that if the combustion is complete, and all the products of combustion escape into the room to be heated, the room receives *all* of the heat due to the combustion of the fuel, and no amount of ingenuity can increase this by 1 per cent. If the combustion is not complete the odor will be so vile that no one will tolerate it. In other words, in this class of stoves the efficiency is almost always 100 per cent. and need not be considered at all in selecting them.

From the standpoint of the gas company the field is a very desirable one, but before entering it the manager must inform himself thoroughly and must be equipped with the knowledge, the energy and the patience to steer his customers clear of the numerous mistakes into which they are likely to be led in the absence of such guidance. The gas heater is still in the process of evolution; the perfect one has not yet been made. It is, therefore, quite dangerous to recommend any special make or pattern. It is much easier and much wiser to confine one's efforts to keeping out those heaters which are constructed on false principles or which are sold on false representations and to recommend and endeavor to introduce those which are constructed on scientific principles and sold without misrepresentation.

DISCUSSION.

MR. WHYSALL:—I agree with the writer, in the statement that it is better to permit all of the products of combustion to remain in the room, rather than to attempt to send a portion of them out.

F. H. SHELTON:—The paper is so general in its sentiments and we are so generally educated in accordance with these sentiments that it is rather hard to give any concrete data that would help very much in the discussion, I fear. It seems to me in connection with heating by gas it might be of interest to bring out the experience of the past season as a result of abnormal coal conditions. In the East we have been especially affected by the scarcity of anthracite coal. Probably that difficulty diminished according to the distance from the anthracite field, generally speaking. At the same time I understand in this section the conditions were very

abnormal the past winter, and I should think it would be of a great deal of interest to put on the records of this Association how much increase in business may be attributable to such unusual coal conditions, which perhaps recur from time to time. We hope, however, that their recurrence may be at very infrequent cycles in one respect, although if they should recur often enough to greatly increase our heating trade, we might stand our other troubles with a little more equanimity. In Pennsylvania, taking as a basis a number of companies with which I am connected, we attributed about 20 per cent. increase in business to the direct effects of scarcity of anthracite coal. The cooking season was prolonged almost up to Christmas, and as a result of these abnormal conditions we put out more gas in September in the companies with which I am connected, than in August. October almost held to that level, and November fell off but little. We feel that we are 20 per cent. ahead on actual output. On the other hand, of course, was our cost for fuel on the higher scale of prices. The condition of having to both cook by gas and heat by gas rather than by hard coal, led to a good deal of re-discussion of the old quesion of gas heating and experiments along that line. A number of efforts were made to galvanize old heaters thrown aside in the cellar, and clap on ordinary water heaters which were used for the kitchen boiler, in batteries of two, three, four and five, to hot water radiators for house heating, but the time of use was so transient and the conditions so irregular that no particular data, so far, has been obtainable as to the results upon which we could rely as a basis. I think it would be of interest if any one here could tell us of any particular heating by gas in lieu of the ordinary hard coal during the past winter, and furnish any new information or new data which are available on that old conundrum which we all hope to reach and solve some day, but which has not as yet been solved. With the general sentiments of Mr. McDonald's paper I heartily agree. I think we would be very poor gas men if we did not agree with the general policy of putting out only those stoves which are satisfactory, and that we know are satisfactory and stop, to the extent of our power, the putting out of merely temporary devices whose chief effect is to run up quick and large bills. They are the worst kind of boomerang that we can encounter.

Mr. Persons:—I have only one suggestion to make on this subject. The market is flooded with all kinds of heating stoves; very few of them have any decent efficiency. The ordinary heating

stove sold for artificial gas is used only intermittently. It is not used to any great extent. It is used simply a very short time and then turned out, and my belief is that a little star burner—and the smaller the stove the better—is the most economical stove and the best in the long run for the gas man.

I believe the gas companies should take up that part of the business and sell these stoves so cheaply that the department stores will not touch them. I think we should decide on some good stove—make a test of different stoves and decide on some good stove—and then sell the stove so cheaply that department stores cannot afford to handle them. They will buy anything that they can buy cheaply and it is an absolute detriment to the trade to have some stoves put on the mraket which are now offered for sale. I think more harm than good is done in the market with those cheap stoves.

MR. DOHERTY:—I desire to hear from our President. He is in a better position to give information on this subpect than anybody else and I suggest that Mr. McIlhenny take the chair and that the President go down on the floor of the convention and give us a good long talk.

Vice-President McIlhenny then assumed the chair.

PRESIDENT ANDREWS:—As you probably know, we have a coke-oven plant at Hamilton, O., and we have a great deal more gas for illuminating purposes than a town the size of Hamilton would ordinarily demand or require. This led us, of course, to take up the question of distributing the gas for heating purposes, as well as illuminating, to a larger extent that it was ordinarily used heretofore. In carrying out that policy we started this last fall by equipping probably 20 houses with gas under their furnaces. We used every kind of furnace we could find; hot water, steam and the various kinds of hot-air furnaces, together with one of the well-known type of hot-air furnaces, gotten up by an eastern concern for gas only. The results have been what we expected in the way of consumption of gas. They used all we had for them and some more in a good many of the places. In my own residence I put in a hot-air gas furnace and I found that in a house of about 30,000 cubic feet capacity (about a 14-room house), in January, which was our coldest month this year, the consumption averaged about 3,000 feet per day. We used a hot-air furnace and the general type in use. The consumption ran as high as 8,000 feet per day. With hot water, taking the same class of house

as a basis, the consumption seemed to be about two-thirds of what the hot-air furnace used. In other words, the proposition figured out that we got between 6 and 8 cents per 1,000 for our gas for this purpose, and that of course is out of the question except for experimental purposes.

Now, in another class of houses, from three to five-room houses, we took the ordinary inside stove, put the burner in the base, filled it with refuse, and with this apparatus we got fairly good results. I think I can safely say the gas will net us about 25 cents per 1,000 through these stoves, and supply the consumer at a price at which they can afford to use it—they can afford to pay 25 cents for gas under such conditions, using it the year around in an inside stove.

Of course by the use of such a stove with a drum attached, extending up to the second floor, we could heat two floors at the same time. This would naturally save a good deal of heat, which would otherwise be lost or wasted. Heating by means of a furnace and the maintenance of the ordinary temperature in the house we find the people cannot afford to pay a fair price for the gas. When I say a fair price, I mean a fair price for heating; but for the smaller houses, used in the way I have indicated, I think it can be utilized and this field will be developed very largely this summer and the following winter. I agree thoroughly with what Mr. McDonald says, that it is out of the question for a gas man to try to supply gas throughout the winter in a large house. You will find that the most desirable consumption is the spring and fall consumption in houses of medium size and as auxiliary heating in larger houses, where they have furnaces and equipments of that kind. Summing up our experience, I would say that to get a fair result with fuel gas, it will be necessary to sell that gas in the neighborhood of 50 or 60 cents, as Mr. McDonald has indicated, in order to get the people to use it to any great extent.

Mr. McIlhenny:—I think Mr. McDonald has given a very good line of conduct for gas companies, in recommending gas heaters in this latitude. I think it is the best policy for a gas company to recommend heaters for auxiliary use for fall and spring consumption, both for the reason that if the gas were used entirely for heating purposes, it would be imposing conditions upon the gas company with which we might not be able to cope, and also for the reason that the common people could not afford to pay for the amount of gas which would be required at any price which

it would pay the company to sell it for. At the same time while the very general introduction of gas heating stoves for fall and spring use will have the effect of increasing the maximum demand, in the exceeding cold weather during the winter, very many of these appliances will be used, so that the gas must exhibit a very great fluctuation in the amount of gas which may be called for. Many of the heating stoves will be used in exceedingly cold weather in parts of the house which are not otherwise adequately heated or which are not specially heated at any time.

In localities south of this, or in the southern part of the United States gas companies can successfully advocate the use of gas for heating purposes all the year around, so far as being economical to the consumer is concerned. The weather being milder, the necessity for their use is not so often demanded and it is not such a serious item. One company with the affairs of which I am familiar, does a very large business in the sale of fuel gas. They heat, practically, every church in town, entirely with gas and do it advantageously for the company as well as the consumer. It requires but little attention and altogether it has been a great success. That same condition will not, however, hold good in the latitude of Ohio.

I believe that in the course of time the makes of stoves will be improved so that while heating the room they will bring in fresh air at the same time. In fact, this winter I saw a stove which was being tried and which brought a certain amount of fresh air into the room and took all the products of combustion out of the room; apparently it was very efficient as the heat in the outlet tube was very mild.

President Andrews:—Mr. McDonald has read a very interesting paper as the opening remarks on a general discussion of the subject of domestic heating by gas. What he intended to bring out here, I think, was the fact that general heating by gas is limited to certain lines and we would like to hear from those having experience with natural gas, what lines they have found most satisfactory to the consumer in the way of heating and about what was the cost to the consumer, so that we can form some idea whether it is feasible to use the same methods in a limited extent in the sale of gas from an artificial plant.

Mr. Stone:—So far as we have found that a man can heat his house with natural gas nearly as cheaply as the man with coal, provided he wants to use the appliances to do it. If he will put

in the right kind of appliances to do it and have them put in in the right way the bill will be just as cheap as it would be for the man using coal, and this year I think it would be a great deal cheaper. The average consumer, heating an ordinary-sized house of six or eight rooms, by gas, using heating stoves in the house, will pay for gas for cooking and heating in the neighborhood of $6 per month. Some run a little more than that, but very little more. I do not believe any particular bills for heating ran over $8 per month, and that was during the months of January and February—I am taking the worst two months of the year as a basis.

On the other hand natural gas, in our experience, has not been successfully used in furnaces when heating a house by means of a furnace. So far, by the use of the ordinary hot water heater, the bill has been higher than it would be by the use of coal. The bill for a house heated in that way, an eight-room house, would average, we will say, about $15 a month. In my own house we have been using gas, and my bill for November was $5. The bill for December was $10, and the bill for January was $12; and the bill for February was $10, this being for all purposes, heating, cooking and lighting.

I know of a man who has a 14-room house and his average bill for all of his heating and for all of his lighting and cooking for the last five years has been less than $100 for everything. That will give you something of an idea as to how the bills run.

The amount of money that people will pay for gas as fuel is ordinarily 5 per cent. more than they would for coal. After they become educated to the use of it they will not let it go: they would rather stand the increased price than go back to coal because it saves so much dirt, and work is so much handier and cleaner and a woman can take care of it, so that an extra man around the house is not neded. There is no carrying of ashes or coal and they will pay a bigger price for this convenience.

I know of a natural gas town—not my own, but another of 10,000 inhabitants—where they have one meter for three inhabitants or less, and I know of a town of 10,000 inhabitants that has more than 2,300 meters for domestic consumption alone, and the average bill in that town for January and February was somewhat over $10 for each consumer's meter. Some of them ran pretty high, but the average was about $10, and yet there is no kick, if I

may use the expression. The people were satisfied with it and are using more of it each year. The demand is constantly increasing. The price at that town was 27 cents gross, or 25 cents net. The price in our town is 25 cents net for gas that will run pretty close to 1,000 B. T. U. per cubic foot. I have canvassed the situation a little bit, because I felt in my own case that some time I might want to go back to artificial gas. We have made a great many extensions in our lines and put in a great many new services and all of our work has been done with the idea that some day, it may be a good many years hence, we will have to go back to the use of artificial gas. Somebody yesterday said 15 years, some said 20, and some said 25 years before we would have to go back to artificial gas, but some day we undoubtedly will have to return to the use of artificial gas, and we have laid our mains and services with that idea in view.

To a certain extent I have analyzed our accounts and I have wondered what proportion of them were ones we could keep in case we went back to artificial gas, and what portion of our business we would lose. I have come to the conclusion that on our price basis we would lose from one-half to two-thirds of the business we have. There are towns where the people would not pay it. They might use gas for domestic heating during the summer and fall months up to say December and then put in coal, and through December, January and February they would use coal, and then start in March and use gas again, but during the winter months they could not possibly use gas in the furnace because the cost would be far in excess of what they would be willing to expend. On the other hand, from the analysis of our accounts in heating offices and closed buildings, store-rooms and other buildings where you can heat by means of a stove, if a stove is used for that purpose which is adapted to it, a stove that utilizes pretty nearly all the heat furnished by the gas, I am satisfied that we could keep from one-third to one-half of our present business. That is the way I feel about it. For instance, I know of store-rooms in my own town 80 or 90 feet deep, 24 feet wide, ceilings 13 feet high, where the bills have not exceeded $4 per month, and the average will be considerably less than $3, and most consumers would stand a great deal more than that per month, in order to secure the many advantages which result from heating by gas, as compared with coal. He would stand twice as much as that

before he would give it up because as a number of people have said, the secret of success in the fuel gas business lies in two things; one of the things is having appliances adapted to the use of it; then educating the people to the use of these appliances. Do not allow the people to get the idea into their head that they can use it in any old thing and in any place and in any way. You must pick your place where you can use it advantageously, and you must educate the people in the use of it. You must educate them to understand it just as well as you do. You must educate them to understand that there is a limit in its use, that is from the consumer's standpoint. So far as the manufacturer's end of it is concerned, it will be necessary for the gas engineer to get up some system of making gas that is flexible, that will meet the different weather conditions and still have a capitalization that is not too great.

As far as the distribution is concerned, I do not believe under present methods of distributing gas where you put the gas through a high-pressure line and take it to a given point and then reduce the pressure to meet the local needs at that point it would prove any more expensive than to distribute it in the old way. My experience has been with the installation we have, that it does not cost any more to put in a distributing system of that kind than that for the ordinary illuminating purposes.

President Andrews:—Mr. Stone has covered a great many of the points that we all wanted to hear discussed and I am sure we are all obliged to him for what he has said. We would now like to hear from Mr. Barnes.

Mr. Barnes:—If it will be of some interest to the meeting to give you some data on natural gas, I will say that we are developing, I presume, the largest district for fuel gas purposes in the country. To start with, there is included within its limits between 60,000 and 70,000 consumers, embracing congested cities, suburbs and surroundings. We find that in the district I speak of the consumption by meter has settled down to a basis that is almost invariable. For the past five years it has not varied 5 per cent. on the average. The average consumption per consumer has been 166,000 cubic feet per year. I speak entirely of natural gas, the price of which is 25 cents per 1,000.

In the summer time we have in this district from 2,000 to 3,000 consumers whose bills amount to less than 25 cents per

month for the summer months. That includes cooking only, which is done on a very cheap style of gas range made of sheet iron, constructed very economically, with either three or four open top cooking lids and a baker. We have about 4,000 consumers whose bills are less than 50 cents per month during what we call our cooking season. We have isolated cases of say four heaters and a gas range that will run less than $40 per year. We find that for heating purposes in larger houses we can compete with coal and possibly the cheapest coal in the country when heating hot water or steam, but we cannot do it with hot air. In many places where a careful record has been kept, extending over two or three years, we find that we can heat with a hot water system by means of gas at an average of about 15 per cent. less than coal, but we find the most economical way to use gas is in the room in individual heaters of the very highest class and type that are on the market for natural gas.

The gas companies take a great interest in the style of appliance used, more particularly in the range. We find from experience that that has caused us more trouble than anything else. If the range gets out of order the people will kick. We use the ranges made by some half a dozen different concerns, although the most of them now are consolidated into a trust. However, it is not like most trusts are reported to be, taking the popular conception of it. This one has been a benefit to the people. It gave us better appliances for less money than were formerly obtainable when the stoves were manufactured by the individual concerns. We are all particular about advocating the use of a flat top range. We do not advocate the open top range. We do that on account of our experience as to the products of combustion. We found, up until five or six years ago, that our principal consumption was in the better class of houses, and we had very little of one-fire, two-fire and possibly three-fire consumers. But about six years ago we started out to get that class of trade. We had practically everything else and we concluded to endeavor to acquire it. The general impression was formerly that with cheap fuel, the class of people to whom we would have to look as prospective customers were those who were supposed to be able to pay good prices, but we were very much gratified to learn that the percentage of saving was greatest to the people using one, two and three fires. You can readily see, referring back to my

other figures, that when you are supplying a great number or a high percentage of your customers at less than 25 cents per month they are not using it for anything except cooking, and when it comes to a little better class but which are less than 50 cents per month, there is no objection there from a consideration of the price to be paid. As near as I can recollect, taking all of our consumption, the bills will run, month by month, probably as low as $1.02.

MR. DOHERTY :—I never have had any experience with natural gas, but I was very much interested in the figures given by Mr. Barnes, and I was also greatly interested in some of the information brought out in Mr. McDonald's paper. I want to compliment Mr. McDonald in pointing out the fact that the chemical laws are as inflexible as the laws of gravity, and no matter how you burn your gas you get just a certain amount of heat from it, no more and no less, and if you burn it in a room without a flue you develop all the heat the gas is capable of developing in that room, and the question of efficiency is not what you get, but how your heat is applied. I think you may safely assume that that heater which will prove the most satisfactory and prove the most efficient will be that form of heater which will give off the largest proportion of its heat as radiant heat.

No one seems to have worked on that line as yet, but by working on that line the heat will travel without regard to the laws of gravity, and it does not heat up the air of the room so much as it affects the opaque objects and the furniture and the bodies of the people in the room, quickly and pleasantly. In a stove that operates almost entirely by heating the air of the room by creating circulation through the heater, the air takes the heat from the stove, carries it to the ceiling, imparts a large part of it to the ceiling and then finds its way down again along the side walls and often alongside of the windows and passes out of the room, without doing its useful work, leaving the products of combustion in the room. I have said before about purified artificial gas, that I am not afraid of the carbonic acid gas produced by the heater, but the thing that worries me is the water-vapor. In an ordinary room, properly ventilated, the amount of carbonic acid gas you produce and maintain in that room, through the combustion of gas, I do not think would be sufficiently great to be harmful. I believe that the ordinary safe limit for carbonic acid

gas in the air is somewhere about 10 times what it is generally believed to be. Carbonic acid gas is not poisonous; it is as inert as nitrogen, and it simply means that it increases the inert portion of the air.

Yesterday we struck this same problem of taking care of this excessive demand, when Mr. Stone's paper was under consideration. Mr. Stone said that was a problem which the gas engineer must solve. I do not believe it is possible for a gas engineer to solve that question. You cannot afford to maintain an expensive apparatus and equipment which will only be used a very small portion of the year. In some cities house heating might be profitably done. In most cities I do not think house heating can be profitably done. You may be able to do house heating, selling gas for all other purposes, and making a profit from your combined sale, but from those sales of gas for house heating purposes alone, rather if you would confine yourself to that sort of sales alone, I do not believe you could make it pay if you got your gas for nothing at atmospheric pressure. I do not think you could afford to compress it and distribute it and maintain the numerous distributing systems and holder capacity on the revenue which would result. Therefore we want to cultivate that class of consumption which will keep our works and our distributing system in use, if possible, the whole 8,760 hours of the year, and if not a continuous even demand on the works and on the distributing system, then the more closely we can approach that condition the better it is for us. My own solution of that problem would be that you would have to put the consumer's charges exactly on the basis of your expenses, and your expenses will consist of two factors: Those expenses which are proportional to the output, such as investment expenses, taxes, insurance and things of that sort, which go on whether any gas is being burned or not. Were you to sell gas on such a system of charging, the tendency would be to bar out that consumer that did not use gas continuously, and to make the price of gas very cheap to those consumers who would use it continuously, or nearly continuously.

Mr. McIlhenny says that the fuel-gas question is possible in the southern cities. I am interested in one southern city—San Antonio, Texas. Three years ago the thermometer went down to 10 degrees below zero in San Antonio, Texas. It may not go there again for 20 years. We cannot afford to maintain a distrib-

uting system and works capacity which will take care of our consumers in weather 10 degrees below zero when that condition of weather comes only once in 20 years. Nearly every speaker has stated that gas could be used as an auxiliary, or as a supplemental method in obtaining heat. I do not think we want that class of trade, or, at least, when we develop our business a little further, I do not think that is the class of trade we want. We want that class of trade where gas will be the prime fuel used, and they will take care of their peaks with coal, or with some other fuel. In Denver, Colo., a great many Backus heaters were sold. It was a heater that took well out there. The climate is very dry, and for that reason you can burn considerable gas without a flue, and without precipitation of water-vapor. The result of our experience is this: If the Backus heaters are not used at any other time during the year they will be used at the coldest period in the year—that is, the people may figure that the heater is too expensive to use, but when a very cold snap comes along they want it, regardless of cost; if their furnace or hot water apparatus will not heat their houses sufficiently, they will then turn on their Buckus heaters and our holders will commence to sink. We have very few cold days in Denver, but were we to get many more Backus heaters it would require increasing our investment for generating and distributing apparatus far beyond the revenue which would come in from those heaters. Therefore, if that business should show signs of ready cultivation, we would not avail ourselves of it beyond a certain point.

HIGH-PRESSURE DISTRIBUTION.

The question of distribution of gas at high pressure does not solve these problems, or, at least, does not entirely solve the problems—no matter at what pressure you may distribute it, your fixed charges will bear the same relation for the same load factor, and by load factor I mean compare your actual output to your possible output, to the capacity of the works which your maximum demand permits you to obtain.

This Association has a committee on the transmission of gas at high pressure. I am sorry that that committee is not now in shape to report. It is interesting to note that the compression of gas is accompanied by considerable loss, not loss of gas, but loss of power. There is one plant in Michigan which supplies

power by compressed air. The efficiency of this plant is about 20 per cent. That is, 20 per cent. of the work done by the prime movers, is delivered by the air motors at the other end of the line. This loss, I think, is divided up about as follows: Eight per cent. of the total loss is in the mechanical loss of the compressor; 7 to 10 per cent. is the loss in transmission, and 12 to 15 per cent. is the mechanical loss in the motors. The difference is the thermal loss due to compression and re-expansion without re-heating.

President Andrews:—This question of compression seems to be more or less an important factor in the consideration of the subject of domestic heating by gas. I should be very glad to hear from some one who has used compressors for some time, as to the approximate cost per 1,000 feet for compression. Probably Mr. Shelton would favor us with a few remarks on that subject.

Mr. Shelton:—It depends upon what kind of a compressor you have, as well as many other conditions which may have an important bearing on the subject. My impression is that the cost will run from 1.5 to 0.75 cents per 1,000 feet compressed.

Mr. Whysall:—I had some experience a few years ago in compressing natural gas through 14 atmospheres by two stages and on a basis of $2.10 per ton for run of mine coal it cost us 0.75 cents per 1,000 for labor and fuel and we were handling from 15,000,000 to 18,000,000 cubic feet per day.

Mr. Stone:—I would like to know if there is any loss in the quality or in the efficiency of the gas delivered at the other end?

Mr. Shelton:—On the other question I think it only fair to say that the volume has a great deal to do with it. When compressing a relatively small volume of gas compared with the total volume compressed, for example with natural gas consumption where pressures are falling, compressing 10 to 20,000,000 cubic feet to push through a small pipe line to adjoining towns of 2,000 people to supply a running gas-works there, or a gas district that otherwise might not have it, I think the cost will probably run from 1 to 1.5 cents per 1,000. That is the cost, comparatively, with an ordinary direct-acting non-condensing compressor; but if one has a very large volume of gas to compress they are then justified in putting in a pumping plant which has the last notch of steam economy worked out, and I can see then where the cost of compression would get under 1 cent per 1,000. If one started

from the ground up, using producer gas with a gas engine as a motive power, or some other very cheap fuel available, I believe the compression could, perhaps, be brought down to a cost say of 0.5 cent per 1,000.

On the other question of the apparent result of compression from the standpoint of candle-power, the question has been rather undetermined. There are quite definite figures for the loss of candle-power on relatively high pressures. By that I mean 200 pounds. I know that the Pintsch people have been doing that for a good many years, frequently compressing city gas instead of the usual oil-gas, for local reasons, and they have the results of these experiments or workings. But high compression, as commonly understood at present in an artificial gas-works, means a range of 10, 15 or 20 pounds gage pressure, you may say, and there have been but few accurate tests as yet made as to the extent the candle-power is affected in such works. I have been so busy constructing new lines because of the success of this proceeding that I have not had much time to stop to determine by photometric test just what it amounts to, because the first line demonstrated that there was not sufficient loss in the compression —whatever it might be intrinsically—there was not any sufficient loss to make any difference commercially. There may be a candle or a half candle or a candle and a half. It depends upon the gas and depends upon various conditions, but for all practical questions the gas at the other end of the line in a dozen different lines with which I am familiar, and some of which I am directly operating, is just as salable and just as good and just as practical to the consumer as it can be before compression. Mr. Learned read a paper at the February meeting of the New England Gas Association where he gave the first figures I have seen upon photometric tests in this relation. He took a number of readings, ranging from 5 to 30 pounds compression, and it would seem from his figures that there was a loss of a half a candle and a candle, and in one case I think up to three candles. That is the result. I think it will need a great deal of careful observation, however, and more figures under very different conditions to establish just what the result is. If any illuminants are thrown down in the pipe they seem to be picked up again and carried forward with the gas and distributed. We find no trouble in the pipe line after the first 1,000 feet or 2,000 are passed. Beyond the section affected by the heat

of compression the line is completely dry without exception. As an instance of how far such high-pressure pipe lines may have advanced, I may say that I am connected with one system which has 50 miles of high-pressure line in a scattered suburban territory in which all the laterals are 1.25-inch pipe, where ordinarily they have 4-inch pipes. You can figure for yourselves the saving in the cost of these mains, where the trunk line is 9 miles long, 6 inches in size, and where we serve about 2,000 consumers, and every one with individual house regulators to control the pressure, and that line has been in use for a couple of years. The first six months we had to pick up a few little flaws here and there, but for the last 18 months we have scarcely given a second's thought to it, because of the serenity and satisfaction of its operation, and I can certainly say if we had not been able to put in a small diameter main system that fully one-half of that territory would not to-day have gas.

MR. LYNN:—I have never had any experience in compressing artificial gas; all my experience with compression has been with natural gas. I have never been interested in any artificial gas plant where compression was resorted to. Mr. Whysall speaks of 0.75 of a cent a 1,000 as the cost of compression. I would like to ask if he is compressing it up to 100 or 150 pounds or only up to a pressure of 15 or 20 pounds, such as is ordinarily used in an artificial high-pressure plant.

MR. WHYSALL:—We compress to 250 pounds per square inch.

MR. LYNN:—You see then that is more expensive, a great deal than Mr. Shelton's estimate where he was using a pressure of 15 to 20 pounds.

MR. SHELTON:—I would like to ask Mr. Whysall in that connection whether the 0.75-cent per 1,000 is not also based on the use of natural gas as a fuel, which would ordinarily be much cheaper than coal?

MR. WHYSALL:—It is based on $2.10 per ton for run-of-mine coal.

MR. EYSENBACH:—I think we have gotten off of the question before the house. We started out with the discussion on the subject, "Domestic Heating by Gas" and now we are on gas compression. I would say, however, on this subject that we found when compressing gas from atmospheric pressure to 250 pounds that we were using 3 per cent. of the gas by using a gas engine as a compressor, which is perhaps the best machine that can be used in compressing gas.

The President:—The reason we branched off more than ordinarily from the subject under discussion and on the question of high pressure was owing to a statement made by Mr. Doherty some time ago that if gas were given him free he did not think it could be distributed for domestic purposes in the city of Denver. Of course, the question of the cost of distribution enters very largely into that subject, and for that reason I thought it best to cover this subject probably a little more thoroughly than we otherwise would have done. Coming back to the original subject, "Domestic Heating by Gas," I will ask if there are any other suggestions to be made or discussions on this topic?

Mr. Lynn:—Mr. Jones, of Delaware, has lately installed a natural gas plant at Delaware and I would like to hear what Mr, Jones' experience has been.

Mr. Jones:—Last October, we turned natural gas into our distributing system and it was successfully done. We had no mishaps at all. The first month we distributed as much gas—I mean cubic feet—as we did the entire 12 months pervious. We were forced into the business simply because we did not want the other fellow to come in and drive us out. We have no reason to regret it. All the statements made about domestic heating by gas simply bear out our experience. It has proven to be perfectly satisfactory and with the West Virginia field back of our line we hope to have natural gas for 25 years to come.

Mr. Whysall:—My experience indicates that consumers will expend about so much money for fuel each year. If it is cold they will pay out $60 or $70, as the case may be. If you sell gas at a flat rate, so much per fire, you can depend upon getting about the same amount of money from them as if you put them on a low-rate meter basis. There is not any perceptible change in the amount of money they exchange for fuel. As you increase the price of gas they will decrease the number of fires and increase the efficiency of the apparatus or appliances.

President Andrews:—Gentlemen, I am very glad to observe General Hickenlooper coming up the aisle. I know it will give us all pleasure to hear a few words from him.

Gen. Andrew Hickenlooper:—Mr. President and Gentlemen: It certainly affords me a very personal pleasure to be present with you for a moment or two this morning, and to express my sincere desire that your presence in Cincinnati will be

in every way enjoyable and profitable. I regret that business of unusual importance and pressing necessity, supplemented by a very brief leave of absence which I have taken, has thrown me rather in the background in the accomplishment of all that a gas manager usually has pressing upon him, and at the same time do what I could for your entertainment during your brief stay in our city, but to compensate for that I have directed the young men of our staff to cut loose and do what they can to add to the comfort of your stay with us. They will be with you from time to time. They are a modest set, but in time I trust you will not hesitate to return to them the warm hand of fellowship and cordiality. I can only add that it will afford me great pleasure to respond in any way within my power in assisting you to have an enjoyable and profitable meeting.

THE PRESIDENT:—We seem to have pretty well covered this subject of domestic heating by gas, and, incidentally, the question of high pressure. In conclusion, we would be glad to hear a few words from Mr. McDonald, the author of the paper.

MR. MCDONALD:—Gentlemen, I notice a few things only upon which it would pay to say anything more. Mr. Persons said that the market was flooded with stoves of low efficiency. I tried to bring out the fact that all stoves that burned the gas were of the same efficiency, and that was one thing that we did not have to look out for. What Mr. Doherty said about radiant heat is eminently good. The more the heat can be made radiant the better for the comfort of the apartment, and my own experience is that certainly not to exceed 20 per cent. can be made radiant, and that can best be accomplished by heating an asbestos wall with a Bunsen flame. Mr. McIlhenny said that companies farther south could afford to sell gas for the heating of entire houses. I differ from him most decidedly. On the contrary, the farther south you go the greater would be the difference between the average demand and the peak. If you go down to Mobile, Ala., you have there some winters where you would sell but little gas for heating. Then another winter when the thermometer would go below zero, and your consumers would call on you for a supply which would exhaust your resources in two hours. I do not think in any climate gas can be relied upon for the heating of houses profitably to the company. The heating of a church is different from the heating of a house. People go to church only once in a while. Mr. McIlhenny also said that he saw a stove lately which brought in fresh

air from out-of-doors and heated it, and thereby helped ventilate the room. I have no doubt he saw it, but it is an absolute illusion. If a stove will do that and do the room no harm, don't try to get it to do any more good. Whatever foul air goes out of the room, fresh air will come in to take its place by leakage, which you could not avoid if you were to construct a room expressly for the purpose of avoiding it. All that you can ask for that stove is not to do anything more deleterious to that room than give off carbonic acid gas and water-vapor. I want to take issue with the eminent authority, Mr. Doherty, on one point. He said that a gas company could not afford to distribute gas for fuel if it was given to them at atmospheric pressure for nothing. I will make a standing proposition that if anybody will give me gas for nothing at atmospheric pressure and agree to give me enough of it on cold days, I will distribute it for fuel and will have much the best end of the bargain.

Gentlemen, I was much gratified to see that such few conclusions as I had announced in this paper were so generally agreed to. Those of you who attended the meeting at Springfield about 10 years ago will remember that they were not then so generally accepted.

Mr. Shelton:—I want to see that a vote of thanks goes upon the record to Mr. McDonald for his most excellent paper. His efforts are always vigorous and always bring out discussion. We all admire a man who stands by what he believes. I want to take issue with him, however, by saying that down at New Orleans, which is about the southernmost point with which I have had any experience, we try to do all the house lighting and the heating as well, and we are going to get a big portion of it.

Mr. Doherty:—I want to correct an impression which seems to prevail with regard to the statement I made some time ago. If I did not qualify it at the time I certainly intended to do so. In the statement which I made I referred to the city of Denver, and I will also make the statement that at San Antonio, Tex., if gas were given to us free we could not afford to stand ready to supply the demand at all times for house heating purposes. We could not supply the demand made on us from time to time.

The motion to extend a vote of thanks to Mr. McDonald for the paper read by him was then duly seconded and unanimously adopted.

On motion, duly seconded and carried, the Association then adjourned until Friday, March 20, 1903, at 9:30 o'clock, A. M., Thursday afternoon being spent by the members in an inspection of the coke ovens at Hamilton, O., as the guests of the Hamilton-Otto Coke Oven Company.

Third Day.—Morning Session.

The Association met at 9:30 A. M.

President Andrews:—We will now hear the report of the Committee on Memorials.

REPORT OF COMMITTEE ON MEMORIALS.

To the Ohio Gas Light Association:

Gentlemen:—We have to chronicle the death since the last meeting of the Ohio Gas Light Association of two members, E. H. Jenkins and S. Milo Dole.

Mr. Jenkins was well known to the Association and to the gas fraternity at large. He was born at Indianapolis, Ind., March 4, 1853, and died in San Antonio, Tex., June 25, 1902. His first experience in the gas business was at the age of 16 years, when he entered the employ of the Indianapolis Gas Company. After reaching the position of Assistant Superintendent with that company, he was successively Superintendent of gas companies at Elkhart, Ind.; Cedar Rapids, Ia.: Columbus, Ga., and Covington, Ky. Later he became Superintendent of the Buffalo Gas Light Company, Buffalo, N. Y., and in 1899 he became President and General Manager of the San Antonio (Tex.) Gas and Electric Company and also the Traction Company of that city.

Mr. Jenkins was an honored President of this Association and received marks of distinction from other gas associations. His genial and affable manners made him a host of friends. These qualities, combined with his well-known ability, were particularly displayed in many difficult situations, all of which brought success to him. His standing at all times was high in any locality in which he resided.

S. Milo Dole became a member of the Ohio Gas Light Association in 1902. A young man of great promise, his career has been ended by the Divine Providence, which controls all of our

affairs. He was born October 2, 1865, and died during the present year. He commenced work in 1877 in a printing office in Adrian, Mich., his father dying shortly after this time, the son thenceforth supported the family. While busy throughout the day it is worthy to mention that through the aid of correspondence schools and private instructors, he acquired a complete college and philosophical education. He also studied law. In 1890 he accepted a position with the Adrian Gas Company, and steadily advanced until he became one of its chief officers. Mr. Dole was a respected citizen of Adrian, active in its public and religious welfare. His life was not in vain.

Respectfully submitted,

J. W. R. CLINE,
JNO. MCILHENNY,
Committee.

It was then moved by Mr. Persons, seconded by Mr. Butterworth and duly carried, that the report of the Committee on Memorials be accepted and spread upon the minutes.

THE PRESIDENT:—The next order of business is the

NOVELTY ADVERTISING DEPARTMENT.

B. W. PERKINS, EDITOR.

The following advertising novelties are all that it has been possible to get from members of the Association, and while this number is not so large as I would have liked, there are a number of very good ones which, if followed, will be productive of good results.

NO. I. JOHN D. M'ILHENNY.

A. Tags.—During the past summer round tags were used for advertising gas ranges with considerable effect at Norristown, Pa., and other points. These tags were made of stiff pastboard 2 inches in diameter and bound with a rim of tin for stiffness. A short string was tied to each through a hole punched in the upper part of the pasteboard. The printing upon two of the tags will be seen from the samples, one side being in red and the other in blue.

The tags were obtained, printed complete, from a leading maker of tags, at $5.50 per 1,000 in a 5,000 lot. They were distributed to children leaving school and also given away generally.

They caused considerable talk. Many children came to the gas office to ask for them, and we think the advertisement was the most effective used during the season.

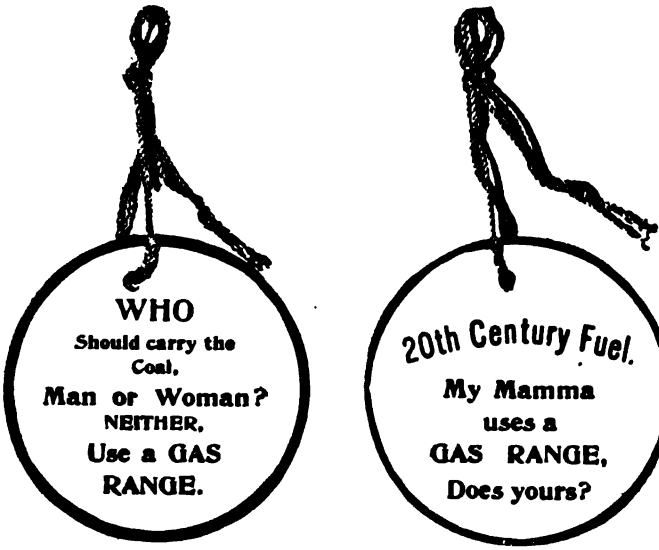


FIG. I. TAGS FOR ADVERTISING GAS RANGES.

B. Statement Slips.—Statement slips were first used, I believe, in Philadelphia a number of years ago, at the time the city managed the gas-works. There being a very general complaint that the statement takers estimated the consumption in a nearby convenient resting house, instead of going to the meters; a statement slip was devised. It has several good points:

USE A GAS HEATER

Gas Company of Montgomery County.

Norristown,................................*190*

Statement of Meter this date..............................*oo Cubic Feet.*

...................................*Inspector.*

The gas consumed is the difference between this statement and the previous statement.

IN THAT COLD ROOM.

FIG. II. STATEMENT LEFT WITH CONSUMER BY METER READER.

The consumer has evidence that the meter was actually read, and is given an opportunity to make a comparison with the previous statement. The inspector leaving it can also avoid conversation as to the amount of the bill, etc. It also has a tendency to make the inspector more careful in his reading.

The expense is very slight, and but little time is consumed in writing out the slip. The inspector each morning before starting out dates the slip with a rubber stamp, and also so marks his name.

The slip also affords a very excellent means of advertising. The upper and lower margin of the front can be utilized as well as the back. A sample slip is shown, the advertising being changed to suit the season.

One gas company uses statement slips regularly, but instead of employing the back for advertising, has a dial printed upon it without hands. The request is made if the statement of the meter dies not compare with the written statement that the consumer will mark the dial according to his reading and send it to the gas office.

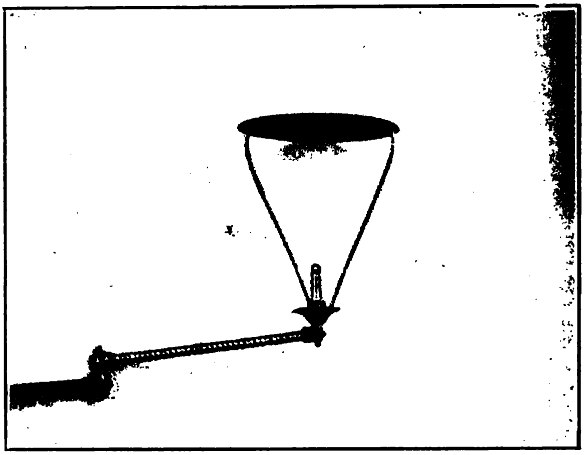


FIG. III. A SIMPLE FORM OF GAS HEATER.

C. *Poor Man's Stove.*—The poor man's stove is a circular sheet of about 20-gage galvanized iron, supported by substantial tinned iron wire over an ordinary gas burner. There is no interference with the light. Over 1,000 of these were given away in

Norristown in the past winter, and while it is at times difficult to ascertain direct results, yet the advertisement was considered well worth the cost, namely, about 6 cents each. With them was given away a leaflet.

There is some efficiency in the hot plate radiating heat as well as checking and distributing the upward flow of the hot products of combustion. The principal advantage, however, of the argument is that it may induce the use of the ordinary gas flame in winter time, and in very mild weather for heating purposes.

D. Gas Bills for Advertising.—There is nothing new in this except the use of one of the margins of the bill for an advertisement in red ink or to attract attention to the back of the bill.

In reference to gall bills, the sample is inclosed more for a wrinkle than an advertising novelty. It will be seen that no dates of meter readings are given, thus avoiding considerable clerical work. Instead, the words "for gas consumed from December to January statement," for example, are employed, the bills being printed each month and dated, say January 26, which is an average date of the meter reading.

NO DISCOUNT WILL BE ALLOWED AFTER FEBRUARY 10.
Save Your Discount.
Office open from 8 A. M. to 9 P. M. on the last two discount days.

Office: 111 East Main Street.

Folio. Norristown, Pa., Jan. 26, 1903.

M..

To GAS COMPANY OF MONTGOMERY COUNTY, Dr.

For gas consumed from December to January statement.

Present index 00
Former index 00
Gas consumed 00 cu. ft. at $1.30 per 1000 cu. ft....$..........
Discount, if paid at office on or before 10th of month, 10c. per 1,00 ....
Net ....

Received payment,

....

(OVER)

Gas Heaters are Convenient to Heat a Room Quickly.

Folio ....

JANUARY.

Amount.......

Discount ......

Net............

FIG. IV. A LABOR-SAVING GAS BILL.

It is very rare that a consumer desires to know the date upon which his meter has been read. This can be obtained from the statement slips left at the house or by inquiry at the gas company office. No complaint has been found with omitting the dates of reading and much time has been saved in the office.

NO. 2. R. SHACKLETTE.

Ornamental Signs.—The following might be used as an advertisement for gas: "The Hotel Gregg, of this city, erected a very fine structural iron portico with the name of the hotel in mosaic glass panels. Surmounting the whole structure is another panel of a similar design which bears the legend: 'Adrian is the home of the Page fence.' This has attracted a great deal of attention from strangers in the city."

NO. 3. F. H. SHELTON.

Service Plate.—This idea comes from the office of the New York and Richmond Gas Company, Stapleton, N. Y., T. O. Horton, Manager:

FIG. V. FLAT RING TO GO ON DISCONNECTED RANGE PIPE.

Where an outlet is left capped in a kitchen or elsewhere in the many house piping jobs that the company covers, they insert a little circular advertising "back-plate" (Fig. V) against the wall over the thread projecting, holding the same in place by a ⅜-inch cap screwed on tight. The plate makes a better finish and has the words, "Buy a Gas Range," or other motto desired. The plates are of cast-iron, can be made for a few cents a pound and painted, working out to a cost of perhaps 2 cents per piece. The diameter is about 3 inches.

NO. 4. C. L. STEENBERGEN.

Exhibition Meter.—I removed the sides and top of an ordinary 3-light meter and the covering of the valve chest, substituting glass in the place of them, and placed it in my show window, passing the gas used in my office through it, thus showing the public that a gas meter was not a tin box full of wheels which the gas company used to swindle their customers. I have found it at all times more than satisfactory and have yet to find a dissatisfied customer, after he has been shown how his meter worked, who did not go away satisfied that it was entirely different from what he thought it was and that it would register correctly.

NO. 5. J. M. ROBB.

Box Kites.—A part of this idea was reported at a previous convention. In putting out the advertisement, the only apparatus required is a large box kite and a streamer with the advertisement written on it. The kite is sent up into the air and the wind unfurls the streamer, making it very legible providing the banner is made of the right size and is not sent up too high. In the instance which came to the writer's attention this advertisement was used at night and a search light was thrown upon the banner.

NO. 6. GEO. WHYSALL.

Thimbles, Keyes and Ranges.—*First,* a sewing thimble made of aluminum on which is inscribed, "Cook with Gas." These thimbles are distributed among the ladies occupying houses in which our solicitors and canvassers are endeavoring to place gas appliances. The thimbles are made up in assorted sizes. *Second,* a steel key ring upon which is an aluminum blank yale lock key and a name tag, made of aluminum, on which is printed, "Key to the successful use of Gas and Electricity.—Evansville Gas & Electric Light Co." The method of using the key ring is to have them dropped on the streets, in public conveyances, and in fact wherever they may be noticed and picked up. *Third,* The Boston Store of this city is a department store that has an attraction arrangement with a man to give cooking demonstrations and at the same time permitting him to sell to the public copies of recipes. The stove mentioned is loaned to the Boston Store by this company; they pay for the gas consumed.

NO. 7. L. KAHN.

Special Dispatch.—The following can be used as a newspaper advertisement:

BANKER'S EXPERIENCE IN GETTING SERVANTS.
THEY DEMAND UNHEARD OF CONDITIONS,
WHICH ARE GRANTED.

PHILADELPHIA, Jan. 23, 1903.—Suburbanites have to deal with the servant-girl problem with a vengeance. Good servants along the main line are as scarce as anthracite coal, and the result has been increased wages and unheard of demands on the part of applicants.

The experience of a prominent banker living beyond Rosemont, illustrates the situation. His family lost two servants and it was necessary to procure two others. Employment agencies and advertising were tried without success. Finally two sisters recommended by a friend of the family came along, one to take the place of housemaid and the other as cook.

When telling about it the banker explained that they "had been paying the departed help $6 and $6.50 respectively, per week, but in this case $8 was demanded and we were not disposed to protest as we needed the help seriously, but that was not all; before the contract was closed the following conditions had to be agreed to:

"(1) To furnish our private carriage to take them to church on Sunday in Philadelphia, and to pay their fare in and out from the city.

"(2) To let them have exactly the same kind and quality of food as served to the family.

"(3) To provide a first-class gas range for the kitchen.

"We were quite willing to concede the third condition, but we thought, and think now that the others were as new as they were tough. However, the girls are with us and we hope for the best."

NO. 7. F. G. CORBUS.

Circulars.—A variety of slips, booklets, etc., as used by the Welsbach Company for distribution, were sent in by Mr. Corbus. He makes the following suggestions, which if followed out, could only be productive of the very best results, and I think is worthy of more than passing attention.

He says: "The distribution of advertising matter is an important feature. Mailing slips are comparatively inexpensive. All gas companies have close friends among the various merchants in their respective cities, and I have no doubt they could arrange with certain of these merchants to enclose with bills, letters or packages, more or less of such matter as they might see fit to issue. This would be particularly true if the advertising matter was of

such character as to incidentally do the merchant a little good. Best results are accomplished not by spasmodic work, but by constantly keeping a particular product or device constantly before the people."

NO. 9. M. W. MALONE.

Co-operative Lighting.—The following newspaper clipping will explain itself. It is hardly necessary to state that gas could be utilized quite as well as electric lights:

"Last night the residents of the capital city who happened to be in the vicinity of the 200 block on East Main Street were surprised indeed at the brillancy of that section of the business portion of the city, as the block was a blaze of electric light. The 100 block, with a large and brilliant illumination furnished by the Madison Gas and Electric Company, and the numerous other electric signs of business houses, looked absolutely pale when compared with the neighboring block below.

"Although the city maintains an electric arc lamp at each end of the block, the merchants have felt for some time that more light was needed, and the illumination displayed for the first time last evening is the result of the arduous work of L. M. Rhodes, of the firm of Dresden & Rhodes, who not only originated the project, but enlisted the co-operation of the other business men in the block, and several other adjoining, and carried the scheme to a successful denouement. Five Nernst lamps of the largest size made, are suspended in the middle of the street about 50 feet apart, and with the city arm lamp at each end of the block gives a total illumination of 10,400 nominal candle-power.

"It is doubtful if there is a brighter block anywhere in the United States than the one in which these business men have their commercial homes. So far as is known, Madison is the first city in which the famous Nernst lamp is used for street illumination, and the merchants who have by their liberal spirit made this possible are worthy of emulation. All the business men without regard to the fact whether their places of business are open evenings or not, have signed the contract with the Madison Gas and Electric Company, and will bear their share of the expense.

"Even the mere fact that the movement was on foot, has caused other business men to look into the matter, and there is little doubt that other blocks will soon be equipped with these brilliant lamps. The contract calls for illumination every night in the year from dusk to 10 P. M."

In addition to the above clipping Mr. Malone says: "As yet we have only lighted this one block, but we already have the signatures of the merchants in the adjoining block to install five more of the six-glower Nernst lamps, and judging from the amount of talk being done, I would not be surprised if we would be able to get a dozen or more of the blacks in Madison before the thing lets up."

NO. 10. IRVIN BUTTERWORTH.

Transparency.—I send herewith a photograph illustrating a novelty advertisement, such as we have recently put into use here.

FIG. VI. TRANSPARENCY IN FRAMES, ELECTRIC LIGHT BEHIND.

It consists of a transparency, that is, a photograph on glass, illustrating a gas stove and advertising its merits. The transparency is framed heavily in black, and attached to the back of the frame is a box in which several incandescent electric lamps are placed in such a way that when the current is turned on them the transparency is brilliantly and suitably illuminated. The picture is

then hung in our office window, or in any other suitable window in the city, and every night is lighted up for the benefit of passers-by. This makes a very attractive and effective advertisement and few people pass it by without looking at it.

NO. 11. MANUFACTURERS' IDEAS.

Attractive advertisements which cannot be described, but will have to be seen, together with one that was issued by the Connelly Iron Sponge and Governor Company, the E. P. Gleason Manufacturing Company, and the Phoenix Glass Company, will make very attractive matter for use in the mails.

NO. 12. FROM *Light.*

Japanese As She Is Wrote.—The following clipping, taken from *Light,* can be remodeled into a very attractive newspaper advertisement:

THE WINTER HAS COMING PEOPLES WANT TO KEEP WARM.

I DEAL BELOW MENTIONED FUELS PROUGHT DIRECTLY FROM MINES AND SALE AT FEW PROFITED PRICES SHOWED BELOW.

	Lamp.	Bluff.	Settlement.
1	Saimioti Smokeless Coal A Ton	925	895
2	Kiushin Coal A Ton	1,250	1,200
3	Iwaki First Class Coal A Ton	910	830
4	Iwaki Second Class Coal A Ton	820	790
5	Gas Cokes A Ton	1,250	1,200

Order Drop A Card To K. Morikawa, Also Lime Plaster Cement, Bricks.

Ishikawa Nakamachi Nichome, Yokohama.

Will be promptly delivered to your Common Ded Place.

NO. 13. BY THE SUBURBAN GAS COMPANY, DARBY AND CHESTER, PA.

Keep Cool.—Use a large fan on which is printed appropriate matter concerning gas stoves, with cuts of same. This is used for general distribution among the residents and forms a very attractive advertisement.

NO. 14. BY THE W. M. CRANE COMPANY.

Various.—They send a variety of novelties, one in the shape of a copper range boiler, which forms the cover of a booklet. Another in the form of a button showing a gas range, another in the form of a small tin box which can be used for holding various

small articles, etc., etc. They also send in one which is worthy of special mention, although it has been spoken of in one of the technical papers. It is a square card cut out of nice material. Through a perforation in the corner is a small bow of blue ribbon, and on the card is printed in nice script, "If you love your wife buy her a gas range." As has been mentioned, these can be sent by mail generally, or kept and sent to young married couples, immediately after the ceremony.

NO. 15. BY A DISCOURAGER OF DULLNESS.

This is a knife sharpener, the contributor of which is not known it makes a good advertisement, however, as it can be put to a useful purpose, is likely to be kept and seen very often.

NO. 16. BY THE DETROIT STOVE COMPANY.

This firm sends out a variety of novelties, such as flat-iron cleaner, pocket mirror, memorandum book, book of puzzles, etc., etc.

NO. 17. FROM SOUTH BEND, IND.

X-rays, Puzzles, Toys and Balloons.—X-ray cards for distribution among the children, a fine "Ad." that will have to be seen to

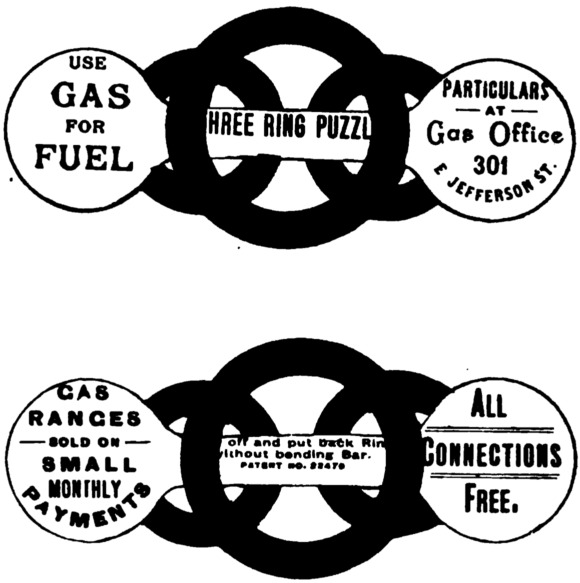


FIG. VII. THREE-RING PUZZLES USED TO ADVERTISE GAS FOR FUEL.

be appreciated. Three-ring puzzles (Fig. VII), magic butterflies string puzzles, stickers which the fitters stick on to everything in town, large seals (Fig. VIII) 4 or 5 inches in diameter, having appropriate matter printed on each side, which are suspended from step irons on poles, harnesses, buggy tops, gas fixtures, and in short any place which they can be hung from. We are also contemplating the use of captive gas balloons, to hold about 6,000 or 8,000 feet, from the bottom of which will be suspended a large rectangular sign. It is proposed to thoroughly advertise the fact that the gas company will have a balloon ascension on a day when the school children will be able to witness it.

FIG. VIII. LARGE SEAL TAG FOR ADVERTISING GAS.

Another good advertisement was used by a hardware firm in this city. It consists of a card 3 inches square. The trick is to cut 1 square inch out of the corner, and then by cutting the remainder in three pieces to make an exact square again. A prize is offered for a correct solution, and it is a very good advertisement and attracts considerable attention.

DISCUSSION.

It was moved by Mr. Persons and seconded by Mr. Butterworth, that a vote of thanks be tendered to Mr. Perkins.

Mr. Butterworth:—If it is in order, I would like to make one or two comments on matters of management or policy which he suggests: For example, second paragraph, he says: "The

request is made, if the statement of the meter does not compare with the written statement, that the consumer will mark the dial according to his reading and send it to the gas office." I would not think that would be very good policy. Meter readers are liable to make mistakes and instead of giving the consumer the impression that errors are liable to occur, I think we should give our consumers the impression that they are not liable to occur. We have here at least an implied statement that errors are very liable to occur in our business, which I think is very bad policy. I simply give that as my own personal opinion for what it is worth.

Again, instead of skimping our gas bills and letting them show as little as possible, I would like to make my gas bills so plain that any consumer, however stupid he might be, would understand just what they meant and what period they covered and all about them. Instead of leaving off the dates of meter readings and thus avoiding considerable clerical work, I think it would pay to employ clerks to have the gas bills in such condition that they may be easily understood by the consumer. These remarks of mine are simply by way of suggestion as to policy and not intended in any way as criticisms.

MR. STONE:—I agree with Mr. Butterworth with regard to the matter of policy. It is better for the gas company's business to be wide open, plainly stated and easily comprehended. We oftentimes have one month that is longer than another and the consumers want their gas bills explained to them. If you have the dates on the bill it is a comparatively easy matter to explain. I think sometimes we do not write our advertisements properly and sometimes give the wrong impression. I saw in a magazine a few months ago—a magazine that purports to be a gas advertising magazine—an advertisement in which the reading was something like this: "The oven of our stove does not explode." The inference from that reading is that the ovens of every other stove are liable to explode and the customer may say, "I thought gas stoves did not explode. I thought there was no danger connected with gas stoves, but I would infer from the reading of that advertisement that there is danger of the oven exploding." And then the gas man is up against it. I think we should be more careful about the reading of our advertisements and the inferences that may be drawn from such reading. I think also

the makers of gas appliances should be more careful about the statements that they make. They can hold up the good qualities of their goods just as much as they want to, but for heaven's sake don't show up the bad qualities of the goods of the other fellow.

MR. PERSONS:—I think Mr. Stone is stretching the point. I don't believe people read advertisements, to amount to anything.

MR. JONES:—Oh, yes, they do.

MR. PERSONS:—I do not believe the ordinary advertisement in the paper or magazine—except a general magazine that is circulated broadcast—I don't believe a local advertisement in a local paper or magazine does much good, unless you do it on a very large scale, enough to attract a great deal of attention. The ordinary little display advertisement of 2 to 6 inches I don't believe does as much good as one postal card would do or as a half day of solicitation would do. However, I do believe in general advertising, in magazine advertising. It attracts attention throughout the United States, general attention. But if you make a large display advertisement, or confine yourselves strictly to reading matter at 20 cents a line, I think your advertising is practically a loss. I do not think it makes much difference what you put in an advertisement under such circumstances.

THE PRESIDENT:—We would like to hear from some one else on this point; if there are no further remarks, I will state the motion before the house that a vote of thanks be tendered to Mr. Perkins for the work performed in preparing and presenting to the convention such an interesting and valuable addition to our gas literature.

The above motion was then unanimously adopted.

THE PRESIDENT:—I will now call on Mr. Doherty for the report of the Committee on Standard Methods of testing Gas-fuel Appliances.

MR. DOHERTY:—At a meeting of the Executive Committee on Tuesday, March 17, a Committee on the Standard Methods of Testing Fuel Gas Appliances was appointed consisting of Mr. Franklin, of Cincinnati; Mr. Stone, of Ashtabula, and myself. This committee has done some very hard work on this problem. They find that they have a difficult task to master, and they do not think that they have as yet mastered it, but they do think that they have made a good start. They called together some 10 or 12

members of the Association this morning at eight o'clock in this room and worked diligently on the problem until the convening of this session of the Association. I will read the report so far as it has been formulated, although I say there are many matters which we will desire to still further revise and correct, as well as to add some new matter.

STANDARD METHODS OF TESTING FUEL GAS APPLIANCES.

REPORT OF COMMITTEE.

No standard method of testing now exists. Every appliance manufacturer shows you tests to prove the superior efficiency of his goods, none of which agree with those shown you by any other manufacturer. Every gas manager buys that line of appliances he believes is the best and most economical, and yet every appliance manufacturer finds some gas manager to champion his products. It is a conundrum. What's the answer? No uniform method of testing.

The American Society of Mechanical Engineers has prescribed a standard method of testing boilers and other apparatus. The National Electric Light Association provided specifications for lamp efficiency tests. The American Institute of Electrical Engineers has provided specifications for the testing of electrical apparatus. The gas engineers so far permit everyone to make his own guess.

Specifications for standard methods for testing fuel-gas appliances means that we will be able first to tell the relative merits of the different appliances now available. In addition to this we will be able to know how much higher efficiency may be expected. We will be able to separate and determine our losses, and when we know what occasions the losses in fuel gas appliances it will probably be an easy matter to lessen them. With improved gas appliances we are then as well equipped for an extension of our markets as we would be by a corresponding reduction in the price of gas. We are quite certain improvements can be secured which will be equivalent to a reduction of 25 cents a 1,000 in the selling price of gas as a means of acquiring more business. If you will figure what your loss of revenue will be by this reduction, we think you will have a fair idea of what the

benefits will be from aggressive work to improve our present fuel gas appliances and to develop other appliances.

It is not an easy matter to specify standard methods of testing fuel gas appliances. The capacity and resultant characteristics of various fuel gas appliances are now left to the caprice of the designer, the line of least resistance in the factory, and the necessity of furnishing an appliance which will save the purchaser a few pennies regardless of efficiency.

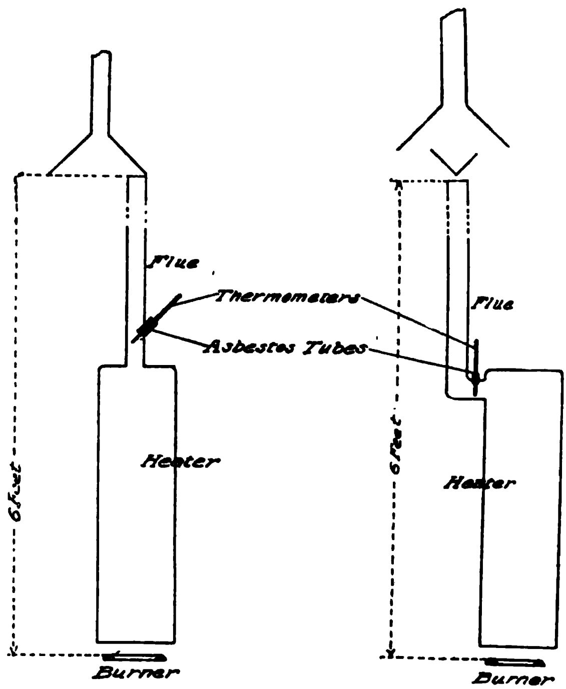
This committee was appointed since this convention convened. The recommendations which follow must therefore be the result of hasty consideration and immature judgment. A start must be made at some time and we think this start should be made at once. The recommendations which follow are tentative only and are expected to be improved and refined by the results which will be secured by their temporary adoption. We believe that best results will follow by making our recommendations in argumentative manner rather than by attempting to lay down precise specifications.

INSTANTANEOUS WATER HEATERS.

These heaters are of two classes, those in which the products of combustion impart their heat direct to the water by contact, and those in which the heat from the products of combustion is imparted through the wall of a coil of pipe. For the present, we do not think it necessary to distinguish between these two forms of instantaneous heaters.

Arrangement.—The heater to be tested shall be connected up with a source of water supply of a uniform pressure and a uniform temperature. Connection with the city water mains will generally suffice. The heater shall not be connected with a flue, but enough flue pipe shall be added to bring the discharge of the products of combustion into the test room at a point 6 feet above the burner of the heater. This recommendation perhaps requires some explanation; we do not feel that uniform results could be obtained by connecting with a flue, for no two flues could be depended upon to give the same draft pressure, and the draft pressure of any flue would depend on many local conditions. We, therefore, think it desirable to test by discharging the products of combustion into the test room. It is reasonable to suppose that every gas-fuel appliance must be so constructed that a

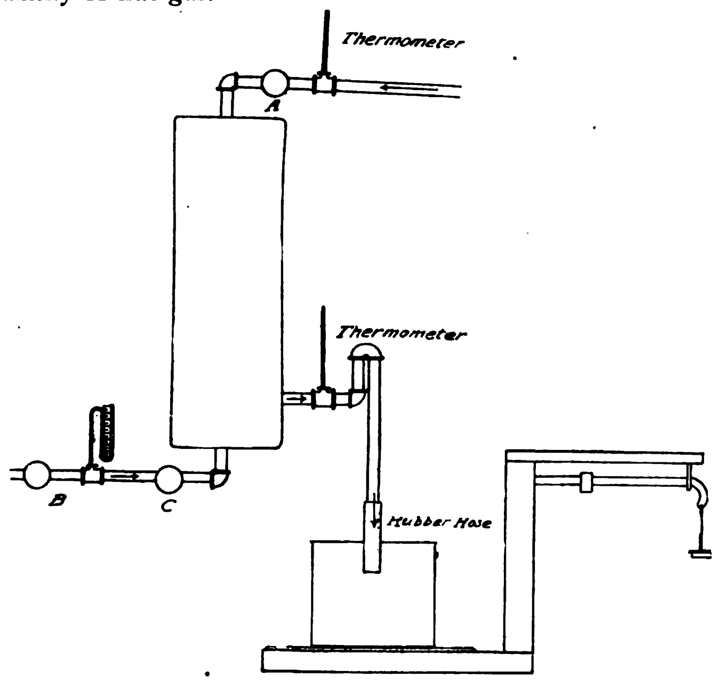
sufficient supply of air will be induced without a flue connection, because they must sometimes be started with a cold flue and a cold flue would produce no draft. It therefore follows that an increase of draft pressure must cause over-ventilation which will curtail the company of the gas appliance, and we are inclined to think that investigation of the behavior of fuel gas appliances by the methods we are outlining will indicate the necessity of regulating this draft pressure, and this can be done by using a broken



FIGS. I AND II. ARRANGEMENT OF FLUES FOR INSTANTANEOUS WATER HEATER.

flue pipe to be set at a fixed distance above the burner of the fuel gas appliance. The arrangement we will probably recommend is shown in Figs. I and II. By the use of an arrangement of this sort, the operating condition of the fuel gas appliance will be under the same working conditions as it was subjected to in the test.

The quantity of the gas supplied to the heater shall be determined by the use of a test meter carefully calibrated for accuracy. Water shall be supplied through a suitable throttling valve at that rate of flow which will give a discharge temperature of 120 degrees Fahr. This temperature is fixed upon regardless of the intake temperature of the water, as the flue gases will be fully saturated at this point and therefore a uniform quantity of heat will be carried off by the vapor of the water suspended in a given quantity of flue-gas.



FIGS. III AND IV. ARRANGEMENT OF WATER CONNECTIONS FOR TESTING INSTANTANEOUS WATER HEATERS.

As the manufacturers do not now rate their heaters in capacity of consumption, and as it would be unfair to fix on any given rate of consumption, we therefore recommend that efficiency be determined at different rates of consumption. The first rate of consumption for an instantaneous heater will be 20 feet of gas per hour, and the efficiency of the heater shall also be determined for each additional 20 feet until the maximum consumption of the heater shall be reached at a 2-inch pressure of water.

Referring to Fig. III, B is the pressure controlling valve, by means of which the gas is maintained at a pressure of 2 inches, and C is the heater stop-cock or needle valve, by means of which the rate of consumption to the heater is controlled. B should preferably be a pressure regulator rather than a valve, as some manipulation will be required to control the pressure when the rate of flow is changed.

The water from the heater shall discharge into a vessel supported upon a platform scales, as shown in Fig. III.

Testing.—The efficiency at each rate of consumption is to be stated in per cent., and shall be determined by dividing the total heat added to the water by the total heat the gas supplied is capable of developing. The amount of heat added to the water shall be determined by taking the temperature by means of thermometers, as illustrated in Fig. III, and the weight of the water multiplied by the difference in temperature will give the number of B. T. U.'s supplied to the water. To determine the quantity of heat the gas was capable of developing, must be done either by a calorimeter measurement or by a calculation from the analysis of the gas, multiplying each elementary gas by the heat of combustion of that gas, as given in various text-books. If the heat of the gas cannot be determined, accurate comparative results can be secured by testing all competitive appliances simultaneously and allowing an arbitrary value for the gas. It is customary to estimate the heating value of coal-gas at 650 B. T. U.'s at a pressure of 30 inches of mercury at a temperature of 60 degrees Fahr.

Losses.—The losses in an instantaneous water-heater are due to, *first*, radiation, and, *second*, sensible heat carried off in the products of combustion. This latter loss can properly be divided into (*a*) the necessary sensible heat carried off in the products of combustion if only sufficient air were passing through the burner to obtain complete combustion, and (*b*) the loss due to over-ventilation, or the unecessary amount of air passing through the heater.

We see no satisfactory manner of determining the radiation loss directly, and must therefore leave this loss to be determined by deduction.

The second loss is determined by taking the temperature of the flue-gases by inserting a thermometer at the base of the flue-pipe and observing the temperature of the discharged gases. By

analyzing the discharged gases by means of an Orsat apparatus, the quantity of each elementary gas can be determined. This quantity multiplied by the specific heat of this gas and multiplied by the observed temperature, will give the sensible heat carried off by that particular gas, and the sum of these quantities will give the total amount of heat carried off by the entire products of combustion. The second loss is then divided into *a* and *b* by calculating the amount of heat which would have been carried out of the flue at this observed temperature had only sufficient air been supplied to theoretically obtain complete combustion.

Gas Analysis.—The flue-gases are most readily analyzed by the use of an Orsat apparatus, as shown in Fig. V.

The apparatus consists of the measuring burette, A, containing 100 cubic centimeters, and of the absorption bulbs, B, C, and D. The burette is enclosed in a glass tube, which serves as a water-jacket. A levelling bottle, L, is connected to the lower end of the burette with rubber tubing. This bottle contains water to which a little salt has been added. By raising or lowering it, the water forces, or draws the gas into the various parts of the apparatus. Connected to the upper end of the burette is a long capillary tube, E, which has three branch tubes, O, P, and R, each supplied with a glass stop-cock. The absorption bulbs are connected to these branch tubes by rubber tubing, as shown in the figure, and usually contain small glass tubes, which serve to bring the various reagents into intimate contact with the gas mixture. The form of apparatus shown has a fourth bulb, H, and a palladium asbestos tube, F, for the determination of combustible gases, but for gas appliance work only the first three bulbs, B, C, and D, are necessary.

The principal ingredients of spent or flue gases are carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O), and nitrogen (N), and these are all that will be determined—the first three by direct reading of the burette and the last by difference.

The reagents used for the absorptions are as follows:

For CO_2: A 16 per cent. solution of caustic potash (KOH), made by dissolving 16 grams in 84 cc. of distilled water.

For O: An alkaline solution of pyrogallic acid ($C_6H_3(OH_3)$). Dissolve 20 grams of pyrogallic acid in 100 cc. of water. When about to use, mix some of this solution with its own volume of the potash solution.

For CO: A strongly acid solution of cuprous chloride. Dissolve 15 grams of the red oxide of copper, Cu_2O, in 100 cc. of strong hydrochloric acid, specific gravity 1.19. Keep this solution in a glass-stoppered bottle with scraps of metallic copper.

The reagents are applied in the order given—bulb B contains the KOH, C the pyrogallic acid, and D the cuprous chloride.

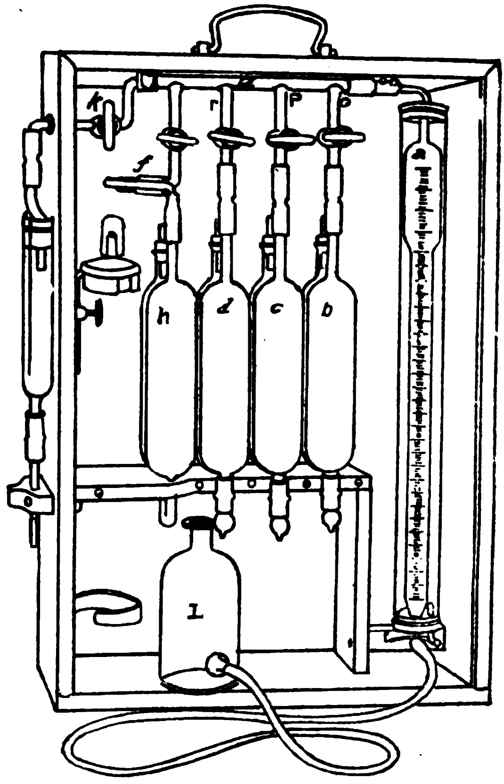


FIG. V.—ORSAT APPARATUS FOR ANALYSIS OF GASES.

The analysis is conducted as follows:

The reagents in the bulbs should be drawn up to marks on the capillary tubes above the bulbs. Then open the stop-cock K, raise the levelling bottle, L, until the burette and capillary tube are filled with water, and close K. Attach the bag containing the sample to the end of the capillary tube, lower the levelling bottle,

and open K. When the water in the burette is 0.5 inch below the zero mark, close K and place the bottle on the table or on the frame, as shown in the drawing. Allow it to stand for a few minutes so that the gas may be at the same temperature as the water in the water jacket, in the meantime detaching the sample bag. It is most convenient to work with exactly 100 cc. of gas and at atmospheric pressure. Hold the levelling bottle by the side of the burette so that the water in the burette is at the zero mark, then pinch the rubber tube between the fingers, set the bottle down, and open K for an instant. Repeat this until the burette reads zero when the water level in the bottle is at the same level as the zero mark. Then open the stop-cock to the bulb, B, raise the levelling bottle, and force all the gas into B, being careful to allow no water to enter with the gas. Then lower the bottle and draw the gas back into the burette until the KOH in B has risen to the mark on the capillary tube above the bulb, and close the stop-cock. Repeat this twice and take a reading with the bottle so that the water level in it is the same as in the burette. Force the gas into B once more and let it stand for a few minutes. Upon bringing it back, if the reading is the same as before, say 20, it shows that there was 20 per cent. of CO_2 in the gas. If the reading differed from the first one, repeat the absorption until the reading becomes constant. Then the remainder of the gas is forced into C and D successively in exactly the same manner, but as O and CO are more difficult of absorption than CO_2, more time is required, and it is well to let the gas remain in contact with the absorbent for from five to ten minutes.

If we obtained readings of 20, 31 and 32 successively, they would indicate that the gas contained 20 per cent. CO_2; $31 - 20 = 11$ per cent. O; $32 - 31 = 1$ per cent. CO; and $100 - 32 = 68$ per cent. N. These results are in per cent. by volume, and if it is desired to give final results in per cent. by weight, this can be most readily done by multiplying the percentage by volume of each constituent gas by the density of that gas, then dividing this product by the sum of the products of the multiplication of all constituents. Each quotient will then give the percentage by weight for that particular gas.

Coal-gas contains a large percentage of H and generally some O. Upon ignition, they unite; 1 part by weight of H, combining with 8 parts by weight of O, to form 9 parts of water. As there

is never enough O in the gas itself to satisfy the H, the remainder must be furnished by the air. Multiply the per cent. by weight of H in the gas by 8 and the result is the amount of O necessary for the combustion. From this subtract the amount of O present in the gas, and the remainder is the O to be obtained from the air. As atmospheric air contains very nearly 23 per cent. by weight of O and 77 per cent. by weight of N, if we multiply the amount of O to be obtained from the air by 3.34, the result will be the "Excess of Nitrogen," so-called because its accompanying O does not appear in the flue-gas analysis, being in the form of water. By means of the relationship between O and N in the air, that is, the proportion 1 : 3.34, the accuracy of a flue-gas analysis can be checked. After reducing the analysis to per cent. by weight, subtract the "Excess N" from the actual N present, that is the remaining N. Sum up all the O in the CO_2, O and CO, and multiply it by 3.34. If the product is not very nearly equal to the remaining N, you may conclude your analysis is wrong.

Taking the density of air as 1, the densities of the other gases will be as follows:

CO_2	1.519
CO	0.967
O	1.105
N	0.970

The sample of flue-gas is readily taken by means of a small pipe or gas jet screwed into the flue, some rubber tubing, glass tubing, and a rubber aspirator. This aspirator is an oval bulb about 4 inches long and 2 inches in diameter, and contains two valves—an inlet and an outlet. Upon pressing it, the outlet opens and contents forced out, releasing the pressure opens the inlet and draws in more gas, while the back pressure closes the outlet. The inlet side is connected by rubber tubing to the pipe, and the outlet side also has a piece of rubber tubing attached, in which is inserted a small piece of glass tubing to facilitate making connections with the sample bag. For collecting the sample, a rubber bag about 8 inches in diameter when inflated, is convenient. It has a piece of tubing attached. All the air is carefully expelled from the bag by rolling it up, and then the glass tube of the aspirator is inserted in the bag and the latter filled with gas by means of the aspirator. When full, the glass tube

is pulled out and a pinch-cock placed around the tube of the bag. To insure a sample free from air, it is best to fill and empty the bag several times before taking a sample for analysis.

Radiation Losses.—By summing the total heat added to the water and the total heat contained in the discharged gases, and deducting this quantity of heat from the total heat the gas was capable of developing, the difference should represent the loss of heat due to radiation.

INDEPENDENT WATER HEATERS.

The efficiency of an independent water heater will vary with the rapidity of circulation. The rapidity of circulation in turn depends upon the resistance through the heater and its connecting pipes and also upon the height of the hot column of water external to the boiler. These conditions tend to increase the efficiency of the heater the lower the resistance through the heater and the lower the heater sets in relation to the boiler.

We cannot say what rise in temperature of the water passing through the heater is most desired, and unless gas companies want to state, when purchasing heaters, how much rise in temperature they want them to give, it will be necessary to test these heaters under several different conditions. There are reasons why it seems almost impossible to accurately measure the efficiency of a heater when connected up with a boiler and under working conditions. This is due in a measure to the fact that the rapidity of circulation will diminish as a greater portion of the water in the boiler is heated, and another factor of error, which cannot be eliminated and cannot be accurately measured, is the radiation from the boiler. We therefore suggest that the heaters be connected up with the boiler and supplied with water of a constant temperature and a constant pressure; the connections between the heater and the boiler to be made with 1-inch pipe and for 90° turns.

Arrangement.—The heater is to be placed in relation to the boiler so that the burner of the heater will be 4 feet below the top of the boiler, and thermometers will be inserted in the supply and discharge pipes from the heater, as illustrated in Fig. VI. The admission of water is controlled by stop-cock F. E is the

cock in the drain pipe, by which the boiler can be emptied. By means of A and B the boiler can be disconnected, and the rate of discharge is controlled by D.

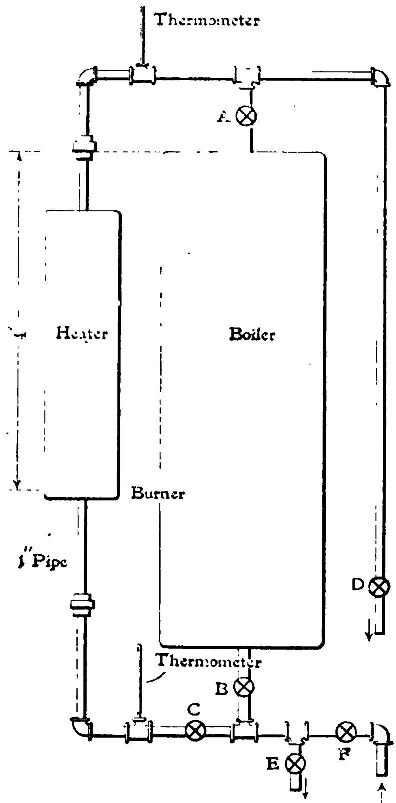


FIG. VI. ARRANGEMENT FOR TESTING INDEPENDENT WATER HEATERS.

Testing.— The heater will be lighted and the consumption of gas regulated to a flow of 10 cubic feet per hour. After this rate of consumption has been maintained for 10 minutes, the rise in temperature of the water will be observed and recorded. The heater will then be disconnected from the boiler by closing stop-cocks A and B, and a test for efficiency made. Open the discharge cock D to such an extent that the flow of water will be maintained at that rate, which will give the same rise in temperature

which was observed when the heater was connected with the boiler. The efficiency will be stated in per cent., which will be determined by dividing the heat put into the water by the total heat the gas supplied was capable of developing.

The same test will be made with 15, 20, 25 and 30 feet of gas per hour, respectively, or whatever maximum consumption will result from a supply of gas at a pressure of 2 inches of water. The boiler and heater should be drained after each test and new water supplied.

But to put competitive heaters on a more equal footing, another efficiency test is to be recommended, and in this test the water passing through the heater will be maintained at a rise in temperature of 50 degrees Fahr. by means of a throttling valve on the outlet of the heater. The efficiency of the heater at this rise in temperature will be determined first on the consumption of 5 cubic feet of gas per hour, increasing the rate of consumption in increments of 5 feet until the maximum consumption capacity of the heater burner has been reached at a pressure of 2 inches.

Losses.—The losses shall be measured in the same way as specified by instantaneous water heaters.

GAS RANGES — TOP BURNERS.

Arrangement.—Sheet-copper pans shall be provided with a uniform diameter of approximately 10 inches and a height of 8

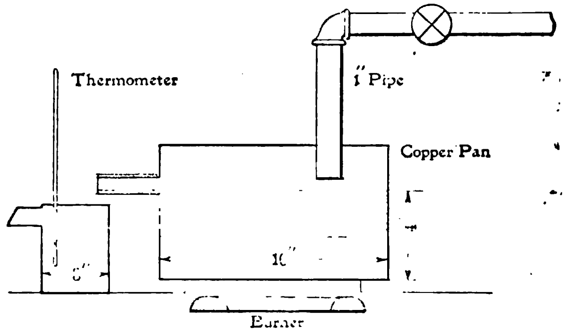


FIG. VII. TESTING TOP BURNER OF GAS RANGES.

inches. Each pan shall be made of No. 26 gage copper and have a 0.75-inch nipple inserted in the side for an overflow, to maintain the water in the pan at a constant depth of 4 inches. The

water from the pan over the burner will flow into a small vessel in which a thermometer will be inserted and provided with a suitable overflow, as shown in Fig. VII.

Water will be supplied to the pan over the burner from a source of constant temperature and constant pressure through a suitable throttling valve, by means of which the water flowing through the pan will be maintained at that rate which will give a rise in temperature of 50 degrees Fahr. A test will be made for a flow of five feet of gas per hour and for each increment of 2 feet additional flow, until the maximum consumption capacity of the burner is reached at a pressure of 2 inches above the atmosphere. The efficiency of each rate of flow will be stated in per cent., which shall be determined by dividing the heat put in the water by the heat which the gas burned was capable of developing.

Testing.—The efficiency of the burner may also be determined by noting how much water it will evaporate in a certain time. The pan used will be of No. 26 gage copper, 10 inches in diameter and 8 inches high, with two handles, but without the overflow. Ten pounds of water are put into the pan and it is set over the burner and the water brought to the boiling point. The pan is then quickly placed on the scales, the weight noted, and the pan replaced over the burner. A stop watch is started at the same time, and the water is allowed to boil for 10 minutes, when the pan is again taken off and quickly weighed, and the consumption of gas noted. For a consumption of 20 feet per hour and less the time will be 20 minutes instead of 10. The efficiency will be determined for each rate of flow of gas in the same manner as before.

The total heat put into the water is found by multiplying the weight of water evaporated by 965.7, the latent heat of steam at a barometric pressure of 14.7 pounds. For other atmospheric pressures, consult any tables on the properties of saturated steam.

We recognize that the burner which is apt to give the highest efficiency under this method of measurement is that burner in which the combustion is concentrated as nearly as possible in the center of the pan, and that such a burner would not give the proper distribution of temperature such as is needed for certain kinds of work, but as the greater portion of the work on the top burner of a gas range is boiling, we therefore have momentarily neglected the question of equal temperature which is desired for griddle cake baking and similar work.

Losses.—The entire loss will be represented by the sensible heat of the escaping gases, and we therefore do not consider their measurement necessary.

GAS RANGES — OVENS.

The determination of rational methods for determining oven efficiencies is a difficult matter. It is highly important for such work requiring the intermittent use of the oven that this portion of the stove should be constructed with the idea of keeping the thermal capacity of the oven at the lowest point possible to enable this portion of the stove to be heated up as quickly as possible. High thermal capacity of the oven racks the walls and renders the oven slow to reach baking temperature, and the heat stored in the oven is dissipated without doing useful work after the baking process has been completed.

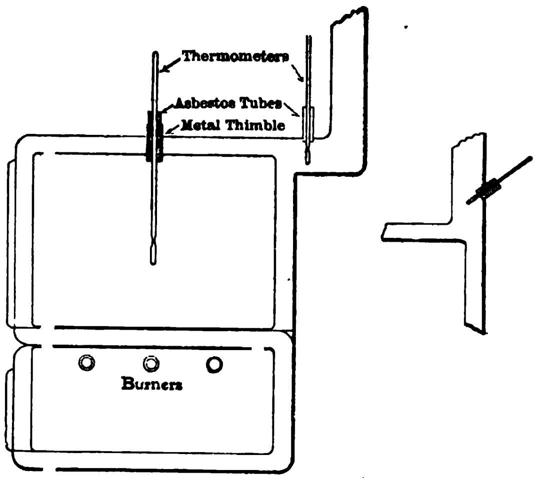


FIG. VIII. TESTING OVENS OF GAS RANGES.

Arrangement.—None of your committee can now say what temperature is required by different characters of work done in the oven. A temperature of 300 degrees Fahr. is required for certain characters of work. We therefore recommend the use of a straight thermometer inserted in a hole drilled through the top of the oven and protected from the heat of the gases in the flues by a thimble of metal or asbestos, as illustrated in Fig. VIII.

Testing.—The bulb of the thermometer is to be inserted in the oven to its center. Starting each test with the temperature

of the oven at the temperature of the testing room (which is to be maintained as nearly as possible at 60 degrees Fahr.) gas will be supplied and burned at the rate of 5, 10, 15, 20, 25 and 30 cubic feet per hour, or at whatever maximum consumption the burner will do up to 2-inch pressure above atmosphere. The time is then noted which is required to bring the temperature of the oven to 300 degrees Fahr. and the consumption of gas is continued at this rate until the thermometer ceases to indicate an increased temperature. The time required to bring the oven to a temperature of 300 degrees is recorded, the final maximum temperature at this rate of consumption and the time required to reach this maximum temperature is also recorded. Uniformity of temperature throughout the oven can be determined by raising and lowering the thermometer, and uniformity of temperature in other parts of the oven can be determined by inserting a thermometer in this same way from the back and also from one side.

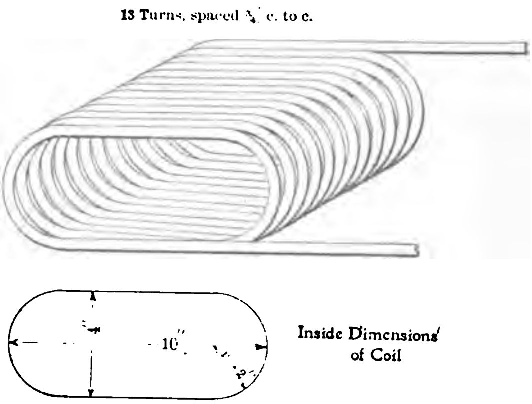


FIG. IX. WATER COIL FOR TESTING HEATING EFFICIENCY OF GAS RANGE OVENS.

The efficiency of the oven shall be determined by the use of a coil of copper tubing 0.5-inch in external diameter and of No. 12 gage thickness, supported on a special wire stand as nearly as possible in the center of the oven. This coil shall be made on a form, as shown in Fig. IX, and shall contain 21 lineal feet of tubing in the oven.

Through this coil water will be circulated and the rate of flow controlled by a suitable throttling valve on the discharge end of the coil. The ends of this coil will pass through the wall of

the oven, as shown in Fig. X, and where the tube passes through the flue in the wall of the oven it will be protected with a thimble of metal or asbestos.

Consumption will be maintained at 5, 10, 15, 20, 25 and 30 feet of gas per hour, or at whatever maximum rate the oven burners are capable of developing at a 2-inch pressure, and the flow of water will be regulated to that rate which will give a rise in temperature of 50 degrees in passing through the coil. The efficiency of each rate of consumption will be stated in per cent., and shall be determined by dividing the total heat added to the water by the total heat the gas was capable of developing.

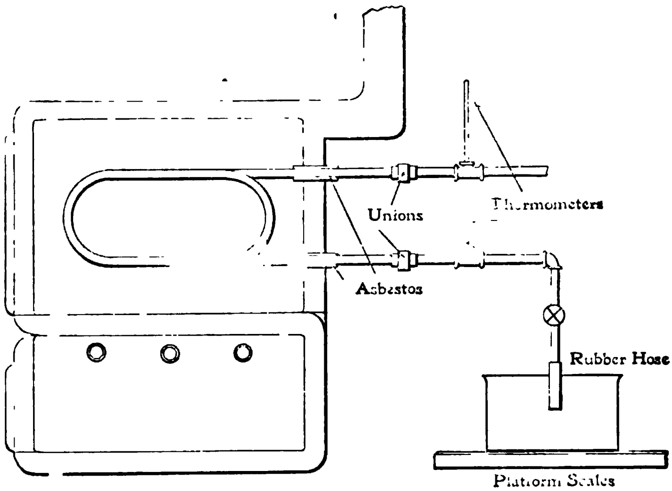


FIG. X. ARRANGEMENT OF WATER COIL IN GAS RANGE OVEN DURING TESTING.

Losses.—The losses will be (*a*) incomplete combustion, (*b*) sensible heat of flue gases, and (*c*) radiation.

Loss *a*, we believe, will be found to be insignificant. This loss will be determined by analyzing the flue gases, and the extent of this loss will be shown by the quantity of unburnt gas present.

Loss *b* will be determined by observing the temperature by means of a thermometer at the point indicated in Fig. VIII, and from this observed temperature the heat contained in the elementary gas will be computed by multiplying this temperature by the quantity of gas and by its specific heat. The sum of these losses will be the total loss of heat in the flue gases, and this total

loss can again be advantageously divided into (1) necessary heat loss and (2) heat loss due to over-ventilation. The first loss can be determined by computing the temperature which would have been carried off in the flue gases had only enough air been supplied to the burner to support combustion, and this deducted from the total loss will give the amount of loss due to over-ventilation or the air which has been taken through the burner unnecessarily.

Loss *c* will be difficult to accurately measure. This requires the maintenance of a constant differential temperature within and without the oven. The room can probably be maintained at a fairly constant temperature, but the only positive temperatures readily obtainable for the interior of the oven are those of boiling water and of melting ice. We are unable to find a suitable means of taking advantage of the positive temperature of boiling water, so therefore select that of melting ice.

Radiation Loss.—A pan will be provided 1 inch high and 10 by 10 inches square. This pan will be set upon a wire support at a height which will locate a block of ice 8 by 8 by 8 inches in the oven in a position as nearly central as possible. This pan will contain several pins, upon which the block of ice shall be set to keep it in position, and the pan will be supported with one corner slightly below the level of the others, to provide for drainage, and from this low corner of the pan a tube will be led through a hole drilled in the door to carry the water of liquefaction into a suitable measuring vessel. The flue of the stove will be stopped with a luted joint, and 20 minutes will be allowed for the rate of radiation to become uniform. At the end of this 20-minute period the catching vessel will be drained, and the time will be noted which is required for the accumulation of 2 pounds of water in this vessel. This can best be done by placing the catching vessel upon a platform scales so set that the beam will tip when 2 pounds of water are contained in the vessel. Ice requires the supply of 141 B. T. U.'s per pound to convert it into water, hence the melting of 2 pounds of ice would require $2 \times 141 = 282$ B. T. U.'s. By computing the area of the inside walls of the oven, the radiation per square inch can be determined. This radiation divided by the difference in temperature of melting ice (32 degrees Fahr.) and the temperature of the air in the room (60 degrees Fahr.) $60 - 32 = 28$, will enable the calculation of the radiation at other differential temperatures by multiplying this quotient by any other difference in temperature. The law regarding radiation is

that the amount of heat radiated will increase in exact proportion to the increased difference in temperature. This law is not strictly applicable to this work, but is probably sufficiently accurate for our present needs.

GAS RANGES — BROILERS.

The efficiency of the broiler is more difficult of determination than any other portion of the stove. The work of the broiler is largely dependent upon the amount of radiant heat the broiler burner will deliver, and the radiant heat is dependent upon the flame temperature, the conductivity of material immediately above the burner, and the reflecting properties of this material.

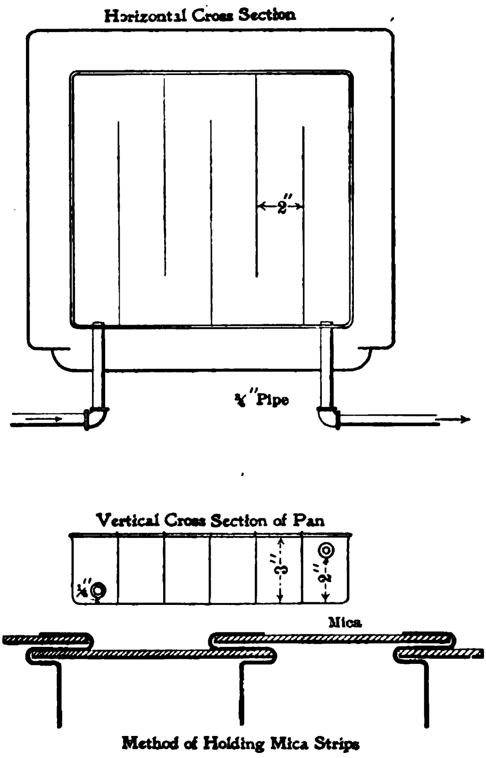


FIG. XI. WATER PAN FOR TESTING RADIATION FROM GAS RANGE BROILERS.

Arrangement.—We are not ready to lay down definite specifications for testing the efficiency of the broiler, but we suggest the use of a modified form of the principle used in the absorption radiometer. In this instrument advantage is taken of the fact that heat rays will not pass through water saturated with alum. It is a well-known fact that water without alum being added is almost completely impervious to the passage of heat rays. We therefore suggest the use of a pan 3 inches deep of metal construction, except the top, which shall be of mica, except for the necessary supporting sash, which shall be of metal also. This pan is to have a length and breadth of 1 inch less than the dimensions of the broiler, and shall be arranged with partitions forming channels approximately 2 inches across, and these partitions will run from alternate sides of the pan to within 2 inches of the opposite side, as illustrated in Fig. XI.

Testing.—Water will be fed to this pan through a suitable throttling valve and a tube passing through a hole in the door of the broiler, and from the front corner of this pan the water shall be taken from the pan into a suitable measuring vessel so arranged that the water in the pan will be constantly maintained at a depth of approximately 2 inches. This pan will be so located in the broiler that the top of it will be 2 inches below the lowest portion of the gas flame. The temperature of the water flowing through this pan shall be maintained at a rise in temperature of 50 degrees Fahr. Efficiency shall be stated in per cent., and shall be determined by dividing the total heat added to the water by the total heat the gas was capable of developing.

Losses.—The losses will consist of (*a*) sensible heat in the products of combustion and (*b*) radiation.

The first loss is measured in the same way as specified for measuring this loss in the oven.

The radiation loss cannot be very accurately measured, as under actual operating conditions this radiation loss would differ somewhat according to the conditions under which it is tested, and we therefore suggest taking radiation loss by deduction.

Respectfully submitted,

HENRY L. DOHERTY,
F. W. STONE,
JOHN FRANKLIN,
Committee.

DISCUSSION.

PRESIDENT ANDREWS:—You have heard the report of this committee. I am sure it covers an important field, much more so than we have been able to appreciate probably on first reading. It is a subject that should be considered carefully. Any discussion on the report will now be in order.

MR. PERSONS:—I move that the report of the committee be accepted.

MR. BUTTERWORTH:—I was going to ask, Mr. President, if it is the intention for this committee or a subsequent committee, after these specifications shall have been adopted, to take up the testing of appliances under these specifications and in accordance with them? What is the intention with reference to appointing a committee or commission to take up the testing of appliances in behalf of the Association and in accordance with these specifications, or whether each individual member may or may not follow them as he chooses?

MR. PERSONS:—I would think that the report of this committee will be for independent use. I do not believe in using the Gas Association to advertise anybody's business. When we come to making a test of different appliances and making a report on them we are going into the advertising business. I do not believe in advertising that at all.

MR. SCHWARM:—My understanding of the appointment of the committee was simply this: That some form or method for the standard testing of all sorts of gas appliances be devised by the Association exclusively for the use of its members and in the interest of no particular appliance, but for the use of everybody connected with this Association.

THE PRESIDENT:—I think the last two gentlemen express the idea we had in view in the appointment of this committee last year. It was the intention, as far as I am aware, to let it go no further than simply standardizing the method of testing apparatus and gas appliances, so that anyone can carry it out for themselves. Are there any further remarks? If not, the motion before the house as I understand it is that the report of the committee be accepted, that the committee be continued, and that discretionary power be granted to the committee to correct and revise the report as in its judgment seems wise to do, and that the report be published the same as if already adopted by the Association.

The above motion was then duly seconded and unanimously adopted.

MR. DOHERTY:—I agree in a measure with what Mr. Butterworth has said and in a measure with what Mr. Persons has said. This Association does not want and it cannot afford to lend itself to advertising anybody's goods. But at the same time there are a great many men who may not be equipped for making a proper test of gas stoves. Now I think if this report is spread upon the minutes of this Association and the committee properly handles this important question to the satisfaction of the members of this Association, it will be adopted by the entire American gas fraternity, and probably by the European gas fraternities as well. The Association work need not stop there. I think it will be its duty to bring out the results by using this system of testing. I think probably the Association could take up the question of testing these appliances because that is the proper method of securing improvement. Unless these specifications are used they will do nobody any good. I do not think anybody need have any fear about this Association lending itself to any advertising scheme. It has not in the past and I believe it will not in the future.

PRESIDENT ANDREWS:—The next business upon the program is the report of the Committee on President's Address.

MR. BUTTERWORTH:—Mr. President, I am not chairman of that committee, nor am I its secretary, but as usual I have been imposed upon and will have to read the report, which is as follows:

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

To the Ohio Gas Light Association:

GENTLEMEN:—Your committee commends the address of your President for its business-like directness and conciseness. The opinions of so active and progressive a gas manager, who is a man of accomplished deeds, rather than untried theories, are valuable, and carry weight by their mere statement, not needing elaboration or lengthy argument. It is especially significant that your President points out to us that the prosperity of our business may not be dependent upon the maintenance of high prices for gas, but on the contrary it may lie along the lines of low prices. In this connection he brings up the most important question of differential rates and advances the rather novel suggestion

that there should be two prices for gas, one for cooking and lighting and the other for heating.

Your committee considers that the question of rates is one of the most important that now confronts us, and we, therefore, recommend that as much as possible of the remaining time of this convention be devoted to its discussion in open meetings, in order that a free and full interchange of views may be had, to the end that we may receive the benefit of the combined judgment and counsel of all our members.

The advantages of high-pressure distribution are also touched upon and, in view of the importance of this subject we recommend that if time permit it also be given further consideration at this meeting.

J. T. LYNN,
IRVIN BUTTERWORTH,
B. W. PERKINS,
Committee.

MR. BUTTERWORTH:—I would say that this report was prepared early yesterday morning, since which time the Association has, anticipating our recommendation, given further consideration and discussion to the subject of high-pressure distribution. It has not, however, touched upon or discussed to the extent its importance merits, the question of differential rates.

It was then moved, duly seconded and unanimously adopted, that the report of the Committee on President's Address be accepted and spread upon the minutes of the Association.

THE PRESIDENT:—Gentlemen, as there are no other pressing matters before us now, I think it will be well to take up the recommendation contained in the report of the committee in regard to differential rates, which they recommend be discussed in open session. In order to start this discussion I would be very glad to call upon Mr. Butterworth for a few words.

DIFFERENTIAL RATES.

MR. BUTTERWORTH:—I think the discussion should be started by some one who has given this question more consideration than I have. There are a great variety of opinions on it and there must be some best way, although local conditions may affect it. There may not be any best way of universal adoption. As in many other

matters connected with our business, local conditions may govern in this instance also. I think the public mind has been educated to the idea that differential rates for almost any commodity or service, based on quantity, are just and that differential rates based upon the purpose for which the commodity is used strikes them as being unjust and unreasonable. I would make that comment upon it. I have no very pronounced theories to advance on the subject.

MR. PERKINS, being called on by the President, said: I think the matter is more local than general. There is a great diversity of opinion as regards differential rates, and I should say it would be governed more by local conditions than anything else. I never have been a believer myself in differential rates to any great extent, except as based upon quantity. I have always thought that gas is worth just as much to burn in a stove as it is worth to burn for illuminating purposes. So far as we are individually concerned, I think we have pretty nearly proved it.

MR. WHYSALL:—I am inclined to the opinion that it is purely a local proposition. We believe in selling gas at one price and we will sell it at any time they want it.

MR. ROPER:—I would like to ask a question, Mr. President. I am about to install a new power plant and I would like to use a gas engine. I would like to know what the general opinion would be in regard to gas supplied for engines as compared with electrical power. The electrical people certainly make a vast difference in their charges according to the amount of power you use. I have a contract for electrical power at a certain figure, provided we use at least 2,000 kws., and if we use less than 2,000 kws., the price is another figure, but if we use more than that they again make a different price. Why shouldn't gas be sold in the same way? I am asking for information now.

MR. COOMBS:—I believe in differential rates based upon quantity and not upon the purpose for which the commodity is used. I think that would be the fairer way to put it.

MR. MCILHENNY:—I think there is a growing use for gas in that way. There are many gas companies which have a sliding scale, giving additional inducements to consumers demanding greater quantities of gas, and the gas companies establishing this custom feel very well satisfied thus far with the results. Some companies give more attention to the use of gas for industrial

purposes and have made radical progress along that line, and with fair success, endeavoring to make extra inducements to use larger quantities of gas at lower prices.

MR. DOHERTY:—I do not believe that I agree with any of the speakers, Mr. President. My views are so different that I do not know whether it is worth while to exploit them. The electrical companies are very rapidly coming to the belief that they should not give differential rates on quantity alone. It has been demonstrated absolutely that it is folly. The tendency is towards the adoption of some system of rating based on the expenses occasioned by each consumer, and the expenses per unit of current sold are not necessarily proportional to the quantity used, but are proportional to the quantity used when considered in relation to the portion of the plant they use. In other words there is not an electrical company that would not be better off if they could cut off about 30 to 50 per cent. of their present consumers. If they could they would be ahead of the game. From 30 to 50 per cent. of their present consumers are probably unprofitable to them. These consumers may be some of the biggest consumers that they have. Take for instance a factory which runs all the year around, but closes down at half-past five. They have occasion to use light but two or possibly three months in the year; then they have occasion to use light only for from a half hour to one hour a day. That means that for a 90-hours' use of certain equipment the electrical company has to get enough out of that to pay its proportionate part of the interest on the investment, together with other fixed charges and operating expenses and station equipment. They will use perhaps $300 or $400 worth of current in those two or three months and for the other nine or ten months of the year they use practically none.

You will find in the electrical journals a great deal of literature on the subject of differential rates and a great deal of this literature I think is applicable to the gas business. I have heard many views given by various gas managers on this subject and at our last convention we took up this subject and printed the views of the ex-President of the Michigan Gas Association, who held that differential rates were improper. I defended the other side, holding that differential rates, while not equitable, were more equitable than a uniform rate—that is, differentiating between the use of gas for lighting and for fuel. The load factor of a sta-

tion selling gas only for lighting would be very low indeed, because they would have to have a plant that is capable of generating and distributing ten times as much as their actual output would prove to be. This is because everybody uses light at approximately the same hour. Now, with fuel gas you get three peaks to your load; sometimes your morning peak is a very long peak; they cook breakfast and then they do their baking and the result is for the same demand you will sell more gas to fuel consumers than to lighting consumers. Therefore, if you had all fuel consumers on your lines your sales of gas would increase, or rather for the same sales of gas throughout the year you would not have to have as big a plant as you would for distributing gas for illuminating purposes only. Hence your expenses would not be as high, and that would diminish your interest charges, taxes and a great many of your other fixed charges. For that reason I justify the lower rate for fuel gas and I think I can demonstrate that this is so by some data in the Question Box. You will find a chart accompanying Question No. 112, showing the different load curves of gas consumption at the Denver station. Now the fuel curve is No. 3, which is the combined load curve of a large number of fuel users made up from the complaint meter records and the biggest peak per consumer on fuel consumption is 9 feet; now for lighting consumption that peak runs up to about 13 feet per consumer. It must be axiomatic that the nearer we can work our works and mains to their maximum capacity continuously, the less will be our fixed charges per unit of output. That makes a very great difference which we may not realize until we stop and study it out, how much of the expense of a gas company is in the nature of fixed charges, and not dependent upon output. All of these fixed charges will be decreased proportionately with the larger output we have to divide into them. This rate question I do not believe is one that a man can give an off-hand opinion upon. I think he must start in and analyze the results he has obtained from his present consumers and then I think he must analyze his expenses, and he must be able to determine what expenses would be increased by additional consumption to the same consumers and what expenses would be increased by additional consumption to additional consumers. Assume that the cost of reading meters and taking care of a consumer's account is about \$3.60 a year, which is about what it is in the city of Denver. Take a consumer

who uses 6,000 feet of gas per year to whom we are selling gas at $1 per 1,000. We must first deduct $3.60 from the $6 for reading his meter and taking care of his account. That leaves us $2.40 for the manufacture of gas, its distribution and all other expenses, or 40 cents per 1,000 cubic feet. If you can sell to a man who uses 6,000 feet of gas at $3.60, plus 40 cents a 1,000, why can't you afford to sell to the big user at that same price? That is virtually what you are doing. You are only getting about 40 cents a 1,000 to cover a large proportion of your expenses.

There are certain expenses of the gas company which bear no more relation to the output of sales than they bear to the rivets in your gas holder. I think the factors upon which we must base our expenses are those expenses which are exactly in proportion to the output; those expenses which are exactly proportional to every consumer; reading meters, making out bills, and so forth; those expenses which are dependent upon the distance which the consumer is from the station; which embrace investment, constituting the distributing system of the plant and so forth, and those expenses which are influenced by maximum demand. The size of our mains is not influenced by the amount of gas we sell, but by the maximum instantaneous demand which is made upon them. I think in the next three or four years there will be a very radical departure from our present method of selling gas. I cannot imagine a more equitable way to sell gas than to sell it per 1,000 feet regardless of other conditions or other expenses. Cases can sometimes be best illustrated by example. Now, for what could you afford to sell gas to a hotel to use under the boilers in case of emergency, or in case there was a shortage of coal? You must remember that we are in a little different position from the average merchant, or men that furnish commodity. He furnishes what he is able to furnish and no more. The supply of gas to the consumer is not within our power, but in his power. He can use as much or as little, clear to the capacity of his service and his meter and we have always interpreted it to be our duty to enlarge that service and enlarge that meter to meet any maximum demand he may choose to put on us. Now there surely must be some limit to which we can afford to go and beyond which we cannot afford to go, and I think that limit is already exceeded in many cases.

President Andrews:—The next business before the Association is the

REPORT OF THE COMMITTEE ON NEXT PLACE OF MEETING.

To the Ohio Gas Light Association:

GENTLEMEN:—The Committee on Next Place of Meeting has been unable to agree, but would suggest the following cities: Toledo, O.; Evansville, Ind., and Cleveland, O., with the recommendation that the Association, by a vote, determine the next place of meeting. Respectfully submitted,

GEO. WHYSALL,
J. G. STEPHENS,
F. W. STONE,
Committee.

THE PRESIDENT:—A motion for the selection of one of these three places will now be in order.

Mr. Whysall then extended a cordial invitation for the Association to meet next year at Evansville, Ind., and Mr. Persons extended an earnest invitation to the Association to meet at Toledo, O.

On motion, duly seconded, a rising vote was taken to determine the place of next meeting as between Toledo and Cleveland, O., and Evansville, Ind. The Association voted in favor of Cleveland, O.

MR. DOHERTY:—Mr. Chairman, I would like to have permission to present another subject before the matter of election of officers is considered. It is something already referred to in the Question Box, and that is in regard to research work. I will simply ask for the adoption of the report and the matter may be left in the hands of the incoming President or Executive Committee, because there are one or two members who wanted to be heard on this subject and one of them is out of the city.

MEMORANDUM REGARDING RESEARCH WORK.

HENRY L. DOHERTY.

The matter of research work has been given some attention by the American Gas Light Association, but this field is so large that were all of the associations to undertake means for carrying out work in this line, they could not even cover a small portion of this field. None of our gas associations are so small but that they should endeavor to contribute their share towards original work of value to the gas fraternity.

The Ohio Gas Light Association took an important step at its last convention when it appointed a committee to devise specifications for standard methods for testing fuel-gas appliances. Should this committee evolve some methods for testing that will reflect the true efficiency of all of our various gas appliances, it cannot but result in an improvement in the manufacture of these appliances, which will have a beneficial effect upon the gas business. It is not enough to know that one water heater and one gas stove are as good as some other water heater or some other gas stoves, but we want to know what percentage of the ideal efficiency is realized. We do not want to stop here, but we want to know what occasions the losses, and we want to know the exact division of these losses between radiation, the effect of over-ventilation, and other causes which produce these losses, as this is the only way we can expect to lessen them.

Were there no other field than work on gas appliances, that alone would warrant this Association in attempting to carry on research work, but there are other fields of importance besides this one. Many of the problems which confront us in the gas business are but imperfectly understood. Some of the formulas which we use are questionable. For years we have accepted the theory that specific heats were practically constant for all temperatures, but in the light of recent experience it seems likely that the specific heat of CO_2 and certain other gases may vary 100 per cent. from the minimum with a sufficient increase in temperature.

It would be impossible to go through the entire list of subjects requiring investigation. In my attempt to edit your Question Box for this convention, I have had my attention directed to many points on which investigation work could be done to the great advantage of the gas fraternity. Take Question No. 3, which is apparently a very simple one: "Assuming that some coal must be stored to insure a supply at the works, is it better to leave the same coal stored all the time for any emergency that might arise, and use fresh coal as far as possible, or is it better to use the oldest coal, and should the old coal be cleaned out once a year?" Nearly every answer received to this question is to the effect that the old coal should be cleared out periodically, or else the oldest coal should be used first. My own belief has always been that the freshest coal should always be used first and stored coal should not be used except in emergency. I had

always supposed this was the general belief among gas engineers until the answers to this question commenced to come in. I then found that I was in discord with every other gas manager that contributed answers to this question.

Time does not permit me to make an extensive investigation, but from the report of the results of some accurate experiments and the estimates of two fuel engineers, the freshest coal should always be used first, and if coal is stored this coal should only be used under necessity. Coal deteriorates much more rapidly at first than later on, and after a certain period of time depreciation is so slow as to be almost unnoticeable. I am speaking now of a coal similar to Second Pool Youghiogheny coal, but I recognize that every coal has its own characteristics. If my assumption is right, a lesser total loss will result from allowing stored coal to remain stored as long as possible, but I do not know that my present belief is a correct one, and I simply mention this as another example to show the opportunities and necessity for investigation work which will prove valuable to the gas fraternity.

No one man or no one set of men can do much work. If this Association is to take up investigation work, it should endeavor to find means to enlist the services of the largest possible number of investigators. It would also be desirable to enlist the services of investigators who are outside of the gas fraternity in addition to all those who are in the gas fraternity, if this can be done. It might be difficult to secure such research work unless there were some reward or some means of proper recognition. The natural thing for an association with funds to do would be to award gold medals for valuable work. The funds of this Association would not permit it to adopt this custom. Even if the funds would permit, I doubt if a gold medal would be any more prized by a recipient than would some proper certificate of appreciation which could be put in more available form for exhibition. I therefore lean to the belief that an engraved certificate should be adopted.

I therefore recommend that this Association elect a Committee on Research Work; that this committee shall hold office subject to removal by the vote of the Association, for a period of two years; that their successors shall be elected a year prior to the expiration of their term. I further recommend that this committee, when elected, shall be authorized by this Association to

secure funds of voluntary subscription to provide an engraved plate for the certificate of appreciation, and that they shall be authorized, upon the collection of such a fund, to provide such a plate; also that they shall be authorized to select certain subjects for investigation, and shall have power to predetermine the maximum and minimum points of credit that shall be given for any detail of investigation or research work, and upon completion of this work they shall recommend to the Association, subject to its action, the authorization of a specified number of accredited points.

The number of points required to obtain a certificate shall be 100. The maximum number of 100 points may be offered for any great undertaking in research or investigation work, or for any one detail of investigation or research work, provided the report furnished is of sufficient merit. For work of lesser importance any number of points may be given from one to 100, and when the investigator shall have obtained an aggregate of 100 points a Certificate of Appreciation shall be issued to him.

I therefore move that this Association create a standing Committee on Research Work; that the members of said committee be elected for a term of two years; that their successors shall be chosen one year prior to the expiration of their term; that this committee be authorized to collect funds by voluntary subscription to provide a suitable plate from which the Certificates of Appreciation may be made; that they be authorized to offer any number of accredited points for any detail of research or investigation work, subject to the approval of this Association; that such research or investigation work may be undertaken by anyone, whether a member of this Association or not; and that the names of holders of Certificates of Appreciation be published with every list of Association members.

On motion, duly seconded, the report of the Committee on Research Work was then adopted.

THE PRESIDENT:—The next order of business is the

REPORT OF THE COMMITTEE ON NOMINATIONS.

To the Ohio Gas Light Association:

GENTLEMEN:—On behalf of the Committee on Nominations, I submit the following report:

Your Committee on Nominations for this Association recommends the following: For

President, J. D. McIlhenny, Philadelphia, Pa.

Vice-President, F. W. Stone, Ashtabula, O.

Secretary and Treasurer, T. C. Jones, Delaware, O.

Members of the Executive Committee, Donald McDonald, of Louisville, Ky., and J. D. Shattuck, of Darby, Pa.

Respectfully submitted,

HENRY L. DOHERTY,
MOSES COOMBS,
W. B. GEORGE,
Committee.

Upon motion, duly seconded, the report of the committee was unanimously adopted.

PRESIDENT ANDREWS:—Gentlemen, it gives me great pleasure to state that John D. McIlhenny has been elected President of this Association for the ensuing year, F. W. Stone for Vice-President and T. C. Jones for Secretary and Treasurer. I am sure we would all be glad to hear from Mr. McIlhenny and I will appoint Mr. Persons to escort him to the chair.

J. D. MCILHENNY:—Mr. Chairman and Gentlemen: It certainly is a very great compliment and honor to have been elected President of the Ohio Gas Light Association, and I assure you I deeply feel it. Such instances make us realize the bright spots in our lives. We should value and cherish any manifestation of esteem or confidence on the part of our fellow men.

I have always taken a very great interest in the Ohio Gas Light Association. This is the tenth consecutive meeting I have attended, and I have always attended the sessions of the Association with a great deal of pleasure, as well as with a great deal of profit. We have seen evidence in previous meetings, and we see additional evidence at this meeting that this Association is endeavoring to do what it can for the betterment and improvement of the profession with which we are connected, and which we love so well. I look forward to the next year, and the succeeding years of this Association with great pride and with great hope and anticipation. I believe we will make our mark in noting the progress

which our profession and business merits. I believe that this Association will do what no other gas association has ever done, and in order to accomplish it the entire and earnest co-operation of all its members is necessary. I thank you all very much for the honor you have conferred upon me.

T. C. JONES:—Gentlemen, I have only to thank you again for this renewal of your confidence, and hope during the year to come you will all remember that we are going to have a meeting in Cleveland next year, and that we must all do everything we can to make the 20th annual meeting of the Ohio Gas Light Association the most brilliant gathering of gas men ever held in this country. I thank you.

MR. DOHERTY:—Mr. President, before closing I move that a vote of thanks be extended to the Cincinnati Gas and Electric Company, to the Stacey Manufacturing Company, to the United States Cast Iron Pipe and Foundry Company, to the Hamilton-Otto Coke Oven Company, and to F. and L. Kahn & Bros, who have made our stay in Cincinnati so pleasant, and to whom we are indebted for courtesies shown to us while here; I also move that a vote of thanks be tendered to President Andrews for his very painstaking work as the presiding officer at this meeting, and his uniform courtesy to the members of this Association; also a vote of thanks to Secretary Jones for his earnest efforts in bringing about and carrying through to completion a very successful meeting.

The above motion, being seconded by Mr. Persons, was unanimously adopted.

On motion, duly seconded and carried, the nineteenth annual meeting of the Ohio Gas Light Association then adjourned.

OFFICERS

OF THE

OHIO GAS LIGHT ASSOCIATION,

1903-1904.

President,

JOHN D. MCILHENNY..........Philadelphia, Pa.

Vice-President,

F. W. STONE..................Ashtabula, Ohio.

Secretary and Treasurer.

T. C. JONES....................Delaware, Ohio.

Executive Committee.

C. W. ANDREWS..................Duluth, Minn.
DONALD MCDONALD ....Louisville, Ky.
J. D. SHATTUCK.....................Darby, Pa.
JOHN FRANKLIN...............Cincinnati, Ohio.
C. A. SCHWARM.............Hornellsville, N. Y.

Finance Committee.

DONALD MCDONALD..............Louisville, Ky.
JOHN FRANKLIN...............Cincinnati, Ohio.
J. D. SHATTUCK....................Darby, Pa.

Past Presidents.

Andrew Hickenlooper	1884-1886
Emerson McMillin	1887
Eugene Printz	1888
Thomas Wood	1889
Edw. Lindsley	1890
Chas. R. Faben, Jr	1891
†H. Wilkiemeyer	1892
Chas. H. Welch	1893
Irvin Butterworth	1894
J. W. R. Cline	1895
Jos. Gwynn	1896
Jerome Penn	1897
W. C. Boyle	1898
†B. P. Holmes, Elected for	1899
†E. H. Jenkins	1899
A. P. Lathrop	1900
George Whysall	1901
Henry L. Doherty	1902
C. W. Andrews	1903

Past Secretaries.

Joseph M. Bate	1884-85
Irvin Butterworth	1886-93
A. P. Lathrop	1894-98

Members of the Ohio Gas Light Association.

(The date with each name is that of Election to Membership.)

Honorary Members.

†S. A. Douglas .... February 18, 1885
Ann Arbor, Mich.

†Joseph R. Thomas .... March 16, 1886
Editor, *American Gas Light Journal,* 32 Pine St., New York, N. Y.

†William A. Steadman .... March 16, 1887
Vice-President and General Manager, Flatbush Gas Company, 819 Flatbush Ave., Brooklyn, N. Y.

John P. Harbison .... March 16, 1887
President, Treasurer and General Manager, Hartford City Gas Light Company, Hartford, Conn.

†Eugene Vanderpool .... March 16, 1887
Civil and Consulting Engineer, 757 Broad St., Newark, N. J.

George G. Ramsdall .... March 16, 1887
Gas Engineer, 530 Broadway, New York, N. Y.

†E. S. Funnell .... September 17, 1884
Albany, N. Y.

Geo. W. Graeff .... March 16, 1886
Philadelphia, Pa.

Malcolm S. Greenough .... March 20, 1889
President and General Manager Cleveland Gas Light and Coke Company, 356 Superior St., Cleveland, Ohio.

Emerson McMillin .... September 17, 1884
President, American Light and Traction Company, 40 Wall St., New York, N. Y.

Forrest E. Barker .... March 18, 1891
Chairman of Massachusetts Board of Gas and Electric Light Commissioners, Room 145, State House, Boston, Mass.

†R. T. Coverdale .... September 17, 1884
President, Rome Gas Light Company, Third Ave., Rome, Georgia.

E. C. Brown .... March 19, 1890
Editor, *Progressive Age;* Treasurer, Rome (N. Y.) Gas Company, 280 Broadway, New York, N. Y.

† **Deceased.**

Alex. C. Humphreys........................March 16, 1892
President, Buffalo Gas Company; President, Stevens Institute of Technology, and member of firm of Humphreys & Glasgow, 31 Nassau St., New York, N. Y.

Andrew Hickenlooper....................September 17, 1884
President, The Cincinnati Gas and Electric Co., Fourth and Plum Sts., Cincinnati, Ohio.

†Asa S. Bushnell........................September 17, 1884
Springfield, Ohio.

Active Members.

Abbott, E. D................................March 15, 1893
Superintendent, Springfield Gas Company, Springfield, Ohio.

Addicks, Walter R..........................March 21, 1894
Vice-President, Consolidated Gas Company, 4 Irving Place, New York, N. Y.

Alcott, F. L.................................March 21, 1900
General Manager and Secretary, The Standard Lighting Company, Cleveland, Ohio.

Allen, G. A..................................March 19, 1890
Secretary, Zanesville Gas Light Company, Zanesville, Ohio.

Andrews, C. W............................March 16, 1898
President, Hamilton-Otto Coke Company; Hamilton Gas Light & Coke Company, and General Manager, Zenith Furnace Company, Duluth, Minn.

Arthur, Chester L..........................March 20, 1901
Vice-President and Secretary, The Upstill-Arthur Coal Company, 605 Cuyahoga Building, Cleveland, Ohio.

Backus, Q. S..............................March 20, 1895
Williamsport, Pa.

Baehr, William Alfred.....................March 18, 1903
Engineer, Laclede Gas Light Company, St. Louis Mo.

Barbour, Wm. Tefft........................March 21, 1900
President, Detroit Stove Works, Detroit, Mich.

Barnard, F. F..............................March 18, 1903
Superintendent, Wilmington Gas Light and Coke Company, Wilmington, Ohio.

Barnes, George W..........................March 16, 1898
Salesman, Equitable Meter Company, 226-228 First Ave., Pittsburgh, Pa.

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†Deceased.

Barthold, W. H. . . . . March 18, 1903
Superintendent of Manufacture, Grand Rapids Gas Light Company, Grand Rapids, Mich.

Baxter, Isaac C. . . . . March 16, 1898
President, Bucyrus (Ohio) Gas and Electric Company, Wayne County Bank Building, Detroit, Mich.

Beam, Frank L. . . . . March 21, 1900
Director, Coshocton Gas Company and Hillsboro Light and Fuel Company, Mt. Vernon, Ohio.

Beckwith, J. W. . . . . March 20, 1901
Superintendent, Oberlin Gas and Electric Company, Oberlin, Ohio.

Bender, W. E. . . . . March 20, 1901
Secretary, Hamilton Gas Light and Coke Company, Hamilton-Otto Coke Company, 38 N. Tenth St., Hamilton, Ohio.

Bernstein, S. . . . . March 16, 1892
President and Treasurer, The S. Bernstein Company, 86 W. Broadway, New York, N. Y.

Blinn, A. C. . . . . March 19, 1902
Superintendent, Sandusky Gas & Electric Company, Sandusky, Ohio.

Blowers, Frank W. . . . . March 18, 1903
Secretary and General Manager, Kalamazoo Gas Company, Kalamazoo, Mich.

Boal, Stanhope . . . . March 15, 1899
Vice-President, The Favorite Stove and Range Company, Piqua, O.

Booth, Miller . . . . March 21, 1888
Secretary, Bellaire Gas and Electric Company, Bellaire, Ohio.

Boyle, W. C. . . . . March 16, 1892
President, The Salem Gas Light Company, Salem, Ohio.

Bredel, Fred . . . . March 19, 1900
President, Fred Bredel Company, 405 Keene St., Milwaukee, Wis.

Brooks, Harry S. . . . . March 20, 1901
Traveling Salesman, The Wm. Resor Company, Cincinnati, Ohio.

Buck, Earle H. . . . . March 18, 1903
Manager, Citizens' Gas Light Company, Vincennes, Ind.

Butterworth, Irvin . . . . February 18, 1885
President and General Manager, Detroit City Gas Co., Detroit, Mich.

Byers, C. A. . . . . March 20, 1895
With Ames Bonner Company, Toledo, Ohio; Consulting Engineer of Bristol Gas Light Company.

Calender, E. P. . . . . March 19, 1890
Editor, *American Gas Light Journal,* 42 Pine St., New York, N. Y.

Canterbury, John P. . . . . March 18, 1896
Inspector, Denver Gas and Electric Company, Denver, Colorado.

Carpenter, H. A. . . . . March 15, 1899
Engineer, Riter-Conley Mfg. Company, Pittsburg, Pa.

Cavenagh, Frank . . . . March 18, 1903
General Manager, The Consumers' Gas Stove and Fixture Company, 256 Huron St., Cleveland, Ohio.

Chollar, Byron E. . . . . March 15, 1899
Engineer, Laclede Gas Light Company, 714 Locust St., St. Louis, Mo.

Clansen, W. F. . . . . March 19, 1902
Superintendent, Portsmouth Gas Company, Portsmouth, Ohio.

Clapp, G. N. . . . . March 20, 1899
Secretary, Treasurer and General Manager, The Middletown Gas and Electric Light Company, Middletown, Ohio.

Clark, Geo. M. . . . . March 19, 1890
President, George M. Clark & Company, 72 Lake St., Chicago, Ill.

Clark, Walton . . . . March 15, 1899
General Superintendent, The United Gas Improvement Company, Broad and Arch Sts., Philadelphia, Pa.

Cline, J. W. R. . . . . March 21, 1888
President, Paris (Kentucky) Gas Light Company, Springfield, Ohio.

Cobb, B. C. . . . . March 18, 1903
Secretary and General Manager, Saginaw City Gas Company, Saginaw, Mich.

Collins, David J. . . . . March 20, 1895
Sales Agent, The United Gas Improvement Company, Broad and Arch Sts., Philadelphia, Pa.

Connelly, J. S. . . . . September 17, 1884
President Titusville Gas Company, Titusville, Pa.

Coombs, Moses . . . . February 18, 1885
Superintendent Gas Department, Youngstown Gas & Electric Company, Youngstown, Ohio.

Coombs, Fred S. . . . . March 21, 1900
Superintendent Meter Department, Youngstown Gas & Electric Company, Youngstown, Ohio.

Coons, W. V. . . . . March 21, 1900
President, The Citizens' Gas Light and Coke Company, of Findlay, Ohio, 906 Williamson Bldg., Cleveland, Ohio.

Corbus, F. G. . . . . March 21, 1900
Manager, Cleveland Department, Welsbach Company, 167 Euclid Ave., Cleveland, Ohio.

Cressler, Alfred D. . . . . February 18, 1885
President, Kerr-Murray Manufacturing Company, Fort Wayne, Ind.

Critchfield, Chas. V..........................March 21, 1900
Secretary and Treasurer, The Hillsboro Light & Fuel Company, Hillsboro, Ohio.

Critchlow, E. C..............................March 18, 1898
Manager, Citizens' Heat and Light Company, Elwood, Ind.

Daugherty, George..........................March 19, 1902
Foreman, Warren Gas Light Company, Warren, Ohio.

Davidson, J..................................March 15, 1899
Director, Ironton Gas Company, Ironton, Ohio.

Dawes, Beman G..........................February 3, 1897
President and Treasurer, The Newark Gas Light and Coke Company, Newark, Ohio.

DeArmon, Chas. W..........................March 16, 1892
Secretary and Treasurer, Piqua Gas Light and Coke Company, Piqua, Ohio.

Dell, John...............................February 18, 1885
President and General Manager, Missouri Fire Brick Company, 411 Olive St., St. Louis, Mo.

Dickey, Charles H..........................March 20, 1889
President, Maryland Meter Company, Baltimore, Md.

Dickey, Edmund S..........................March 18, 1903
Treasurer and Manager, Maryland Meter Company, Baltimore, Md.

Dickey, George S............................March 20, 1889
With Maryland Meter Company, 88 Jackson Blvd., Chicago, Ill.

Dickey, Philip S............................March 15, 1893
With Maryland Meter Company, Baltimore, Md.

Dickey, R. R...............................February 18, 1885
President, The Dayton Gas Light and Coke Company, S. W. Cor. Main and Second Sts., Dayton, Ohio.

Doherty, Henry L..........................March 20, 1895
General Manager and Chief Engineer, American Light and Traction Company, 40 Wall St., New York, N. Y.

Dolph, Alex. M.............................March 18, 1903
President and Treasurer, Paris (Kentucky) Gas Light Company, 3483 Evans Place, Clifton, Cincinnati, Ohio.

Douglas, Henry W..........................March 19, 1899
General Manager, Ann Arbor Gas Company, Ann Arbor, Mich.

Droulliard, G. L............................March 18, 1893
Traveling Salesman, The Kanawha Coal and Coke Company, Fourth and Elm Sts., Cincinnati, Ohio.

Douthirt, W. F.............................March 16, 1898
Assistant to the Treasurer, United Gas Improvement Company, Broad and Arch Sts., Philadelphia, Pa.

Dunbar, James W. . . . . March 15, 1889
Superintendent, United Gas and Electric Company, 507 Bank St., New Albany, Ind.

Dwyer, Francis T. . . . . March 15, 1899
Vice-President and Secretary, The Ideal Manufacturing Company, Detroit, Mich.

Eaton, Alfred B. . . . . February 3, 1897
Western Sales Agent, The United Gas Improvement Company, 70 Wabash Ave., Chicago, Ill.

Eilbeck, A. B. . . . . March 15, 1899
40 Wall St., New York, N. Y.

Elles, Edward J. . . . . March 18, 1903
Superintendent, Gas Department, Evansville Gas and Electric Company, Evansville, Ind.

Eysenbach, E. E. . . . . March 18, 1898
Superintendent, Distribution, St. Paul Gas Light Company, St. Paul, Minn.

Evans, Chas. H. . . . . March 20, 1899
404 Royal Insurance Building, Chicago, Ill.

Faben, Chas. R., Jr. . . . . March 21, 1888
General Manager, The Toledo Gas Light and Coke Company, 327 S. Erie St., Toledo, Ohio.

Feurtado, R. S. . . . . March 18, 1903
General Superintendent, Western Gas and Improvement Company, 4401 Indiana Ave., Chicago, Ill.

Field, Frank H. . . . . March 19, 1902
Manager, Welsbach Company, Columbus Department, Columbus, Ohio.

Floyd, H. E. . . . . March 19, 1890
Of James R. Floyd's Sons, 539 W. Twentieth St., New York, N. Y.

Forstall, Alfred E. . . . . March 20, 1901
Consulting Engineer, 58 William St., New York, N. Y.

Foster, B. P. . . . . March 16, 1898
Secretary and Treasurer, Northern Gas and Electric Company, Norwalk, Ohio.

Franklin, John . . . . March 16, 1898
Superintendent of Distribution, The Cincinnati Gas and Electric Company, Main Ave., Norwood, Ohio.

Franklin, H. C. . . . . March 18, 1903
Superintendent Public Lighting, Cincinnati Gas and Electric Company, Hudson and Regent Sts., Norwood, Ohio

Forbes, James . . . . March 15, 1899
Superintendent, Chattanooga Gas Light Company, 619 Cherry St., Chattanooga, Tenn.

Gardner, W. H . . . . March 19, 1902
Treasurer and Manager, Valparaiso Fuel and Light Company, Valparaiso, Ind.

Garrison, F. L . . . . March 18, 1896
President, The Kanawha Coal and Coke Company, Fourth and Elm Sts., Cincinnati, Ohio.

Gartley, W. H . . . . March 21, 1888
Engineer, Philadelphia Gas Improvement Company, Richmond and Tioga Streets, Philadelphia, Pa.

Gassett, A. L . . . . February 3, 1897
Secretary, Economy Stove and Manufacturing Company, Detroit, Mich.

George, Wm. B . . . . March 15, 1899
Assistant Secretary, Union Light, Heat & Power Company, Covington, Ky.

Gillette, Melville M . . . . March 15, 1899
Secretary and Treasurer, Newark Natural Gas and Fuel Company, 49 N. Third St., Newark, Ohio.

Gillespie, Joseph M . . . . March 18, 1903
Superintendent, The Washington Gas and Electric Company, Washington C. H., Ohio.

Gray, A. Ross . . . . March 18, 1903
Traveling Salesman for S. R. Dresser, Bradford, Pa.

Green, James . . . . March 15, 1899
President of Sedalia Gas and Fuel Company, Moberly Gas and Electric Company, and Greencastle Gas and Electric Company, Manchester and Sulpher Aves., St. Louis, Mo.

Gregory, John M . . . . March 20, 1895
Superintendent, Bellefontaine City Gas Works, Bellefontaine, Ohio.

Gribbel, Wm. S . . . . March 16, 1892
Manager, John J. Griffin & Company, 559 W. Forty-seventh St., New York, N. Y.

Guldlin, O. N . . . . March 21, 1888
President and Engineer, The Western Gas Construction Company, Fort Wayne, Ind.

Gwynn, J W . . . . March 21, 1888
Manager, The Bucyrus Gas and Electric Light Company, Bucyrus, Ohio.

Hamlink, L. C . . . . March 20, 1901
Assistant Engineer, Laclede Fire Brick Manufacturing Company, Manchester and Sulphur Aves., St. Louis, Mo.

Hanley, E. W . . . . March 15, 1899
Secretary and Treasurer, The Dayton Gas and Fuel Company, 218 S. Jefferson St., Dayton, Ohio.

Harrop, H. B. . . . . .March 18, 1903
Chemist, Milwaukee Gas Light Company, 528 Cass St., Milwaukee, Wis.

Harper, H. D. . . . . .March 19, 1890
Manager, D. McDonald & Company, 34 W. Monroe St., Chicago, Ill

Harris, J. A. . . . . .September 17, 1884
Agent, John J. Griffin & Co., 1513 Race St., Philadelphia, Pa.

Hauk, Chas. D. . . . . .March 20, 1895
Vice-President and General Manager, National Heat and Power Construction Company, 138 S. Sixth St., Philadelphia, Pa.

Hayward, Sterling F. . . . . .Mrach 18, 1891
Treasurer, Connelly Iron Sponge and Governor Company, 395 Broadway, New York, N. Y.

Hedges, J. S. . . . . .March 21, 1888
Secretary and Treasurer, Mansfield Gas Light Company and Mansfield Electric Light and Power Company, Mansfield, Ohio.

Hedges, William C. . . . . .March 15, 1893
Mansfield, Ohio.

Helme, Wm. E. . . . . .March 15, 1899
Of Helme & McIlhenny, 1339 Cherry St., Philadelphia, Pa.

Henderson, E. H. . . . . .March 20, 1895
414 Hamilton Building, Pittsburg, Pa.

Henry, William G. . . . . .March 18, 1903
Vice-President, Detroit Stove Works, 2921 S. LaSalle St., Chicago, Illinois.

Hess, Frank H. . . . . .March 16, 1898
Agent, The Marion Gas Company, Marion, Ohio.

Hesser, C. F. . . . . .March 18, 1903
Superintendent, Business Promotion, The Cincinnati Gas and Electric Company, Cincinnati, Ohio.

Higgins, C. M. . . . . .March 18, 1891
With The Standard Oil Company, of New York, 26 Broadway, New York, N. Y.

Holmes, A. G. . . . . .March 20, 1901
Secretary and Manager, Pittsburg Meter Company, East Pittsburg, Pa.

Hoyte, E. S. . . . . .March 18, 1896
Superintendent of Distribution, Detroit City Gas Company, Detroit, Mich.

Humphrey, A. H. . . . . .March 18, 1903
President and General Manager, The General Gas Light Company, Kalamazoo, Mich.

Humphreys, E. C. . . . . March 20, 1901
Sales Agent, The United States Cast Iron Pipe and Foundry Company, 731 Union Trust Building, Cincinnati, Ohio.

Hyde, Gustavus A. . . . . March 19, 1890
Engineer, Cleveland Gas Light and Coke Company, 85 Kennard St., Cleveland, Ohio.

Jenkins, Albert F. . . . . March 18, 1896
Superintendent, The Newark Gas Light and Fuel Company, Newark, N. Y.

Johnson, E. D. . . . . March 15, 1899
President and General Manager, The P. H. & F. M. Roots Company, Connersville, Ind.

Johnston, John O. . . . . March 21, 1900
General Manager, The Columbus Gas Light and Heating Company, Columbus, Ohio.

Jones, Howard . . . . March 21, 1894
President, Circleville Light and Power Co., Circleville, Ohio.

Jones, T. C. . . . . March 16, 1892
Secretary, The Delaware Gas Company, and General Manager, The Coshocton Gas Company, Delaware, Ohio.

Kahn, Lazard . . . . March 15, 1899
Of F. & L. Kahn & Bros., Hamilton, Ohio.

Kauke, John H. . . . . March 21, 1894
President and Treasurer, Wooster Gas Light Company, Wooster, O.

Kehoe, Frank B. . . . . March 18, 1896
Vice-President, The Portsmouth Gas Company, Portsmouth, Ohio.

Kellum, Benj. J. . . . . March 18, 1903
Manager, Welsbach Company, 70 Wabash Avenue, Chicago, Ill.

Kenan, Norman G. . . . . February 18, 1885
Vice-President, Cincinnati Gas & Electric Company, Cincinnati, Ohio.

Kerlin, E. M. . . . . March 21, 1900
Secretary, The Tiffin Light and Fuel Company, 705, The Nasby, Toledo, Ohio.

Kerlin, R. G. . . . . March 21, 1900
Treasurer, The Tiffin Light and Fuel Company, 705, The Nasby, Toledo, Ohio.

Kirk, D. B. . . . . March 15, 1899
Secretary and Treasurer The Mt. Vernon Gas Light Company, Mt. Vernon, Ohio.

Knight, John J. . . . . March 18, 1903
Vice-President, Kalamazoo Gas Company, 123 South West St., Kalamazoo, Mich.

Knight, William H. . . . . March 15, 1889
General Manager, Cleveland Gas Meter Company, 42 Glendale Ave., Cleveland, Ohio.

Landon, Hugh McK. . . . . March 21, 1900
Secretary, The Manufacturers' Natural Gas Company, 113 Monument Place, Indianapolis, Ind.

Langwith, Frank A. . . . . March 21, 1900
Engineer, New Haven Novelty Machine Company, 114 Fourth Ave., Newark, N. J.

Lathrop, Alanson P. . . . . March 19, 1890
President and General Manager, The St. Paul Gas Light Company, Sixth and Jackson Sts., St. Paul, Minn.

Lea, Henry I. . . . . March 18, 1903
Assistant Engineer, Western Gas Construction Company, Fort Wayne, Ind.

Leakey, Nathan G. . . . . March 21, 1900
Assistant Secretary, The Michigan Ammonia Works, Detroit, Mich.

Light, E. H. . . . . March 20, 1901
Draftsman, The Dayton Gas Light and Coke Company, Dayton, Ohio.

Light, George . . . . March 16, 1887
Assistant Superintendent, The Dayton Gas Light and Coke Company, Dayton, Ohio.

Light, Joseph . . . . September 17, 1884
Engineer and Superintendent, The Dayton Gas Light and Coke Company, 203 E. First St., Dayton, Ohio.

Lindsay, Charles R. . . . . March 18, 1903
Lindsay and Company, Chicago, Ill.

Little, Francis W. . . . . February 3, 1897
Vice-President, Peoria Gas and Electric Company, 125 N. Jefferson Ave., Peoria, Ill.

Lloyd, Ernest F. . . . . March 16, 1902
Vice-President, The Lloyd Construction Company, President and Manager, Adrian Gas Company, 860 Greenwood Avenue, Detroit, Mich.

Low, D. W. . . . . March 19, 1902
Superintendent, Alliance Gas and Electric Company, Alliance, Ohio.

Lynn, James T. . . . . March 21, 1900
President, Port Huron (Michigan) Gas Company, 208 First Ave., New York, N. Y.

Lynn, John R. . . . . March 15, 1899
Superintendent Gas Department, Waterloo and Cedar Falls Gas and Electric Company, 310 East Fourth St., Waterloo, Iowa.

McAdam, Brice . . . . March 15, 1899
Superintendent, Distribution, Milwaukee Gas Light Company, 424 Prospect Ave., Milwaukee, Wis.

McCormack, E. T. . . . . March 16, 1892
Wilmington, Ohio.

McDonald, Donald . . . . March 15, 1893
President, Kentucky Heating Company, Louisville, Ky.

McDonald, Donald . . . . March 21, 1894
Manager, D. McDonald and Company, Albany, N. Y.

McDonald, Wm. . . . . September 17, 1884
Secretary and Treasurer, Bath Gas Company, 51 Lancaster St., Albany, N. Y.

McIlhenny, John . . . . March 20, 1899
Of Helme & McIlhenny, 1339 Cherry St., Philadelphia, Pa.

McIlhenny, John D. . . . . March 16, 1892
President, Gas Company of Montgomery County, Morristown, Pa., 1339 Cherry St., Philadelphia, Pa.

McMillan, John . . . . March 20, 1901
With Welsbach Company, 167 Euclid Ave., Cleveland, Ohio.

Maloney, Andrew P. . . . . March 15, 1899
Contractor, Welsbach Street Lighting Company, 1504 Tioga St., Philadelphia, Pa.

Malone, M. E. . . . . March 19, 1902
Superintendent Gas Department, Denver, Colorado.

Mancourt, Edward M. . . . . March 20, 1901
Western Manager, Fairmount Coal Company, Traction Building, Cincinnati, Ohio.

Mansur, John H. . . . . March 20, 1895
President, Keystone Meter Company; also President, Consolidated Schuylkill Gas Company, of Phoenixville, Pa., Royersford, Pa.

Many, F. B. . . . . March 15, 1899
District Manager, The Welsbach Street Lighting Company of America, 809 Cuyahoga Building, Cleveland, Ohio.

Marks, Wm. D. . . . . March 20, 1901.
President, The City Heat and Light Company, Fostoria, Ohio.

Mason, C. T. . . . . March 21, 1900
Traveling Salesman, George M. Clark and Company, 72 Lake St., Chicago, Ill.

Mason, John T. . . . . March 21, 1900
Assistant Superintendent, Milwaukee Gas Light Company, 7 The Jefferson, Milwaukee, Wis.

Matt, Edward . . . . March 15, 1899
Secretary and General Manager, The Lancaster Gas Light and Coke Company, Lancaster, Ohio.

Maxon, J. H. . . . . March 18, 1896
Secretary and General Manager, The Gallipolis Electric Light Company, Gallipolis, Ohio.

Mayers, J. A. . . . . March 16, 1893
Gas Engineer, Edison Bldg., 44 Broad St., New York, N. Y.

Megie, Benj. F. . . . . March 18, 1903
Manager, Cincinnati Department, Welsbach Company, Cincinnati, O.

Miller, Alten S. . . . . March 15, 1893
Manager, Consolidated Gas Company, 5 West Baltimore Street, Baltimore, Md.

Miller, W. A. . . . . March 19, 1902
Superintendent of Manufacture, Cincinnati Gas and Electric Company, Cincinnati, Ohio.

Milne, D. S. . . . . March 21, 1888
Secretary, Treasurer and Superintendent, The Marietta Gas Company, Marietta, Ohio.

Milsted, Wm. M. . . . . March 15, 1899
Secretary, The American Meter Company, Eleventh Ave. and Forty-seventh Street, New York, N. Y.

Miner, John Read . . . . March 16, 1898
President and Treasurer, The Connelly-Critchlow Company, Conestoga Building, Pittsburg, Pa.

Montgomery, Randall . . . . March 15, 1899
Manager, The Youngstown Consolidated Gas and Electric Company, Youngstown, Ohio.

Moon, O. P. . . . . March 16, 1898
General Manager, National Vapor Stove and Manufacturing Company, Lorain, Ohio.

Morreau, Albert . . . . March 21, 1900
President, The Morreau Gas Fixture Manufacturing Company, Prospect, Erie and Huron Sts., Cleveland, Ohio.

Moses, Frank D. . . . . March 16, 1898
Chief Engineer, South Jersey Gas, Electric and Traction Company, 222 E. State Street, Trenton, N. J.

Mulholland, S. E. . . . . March 19, 1902
Secretary and Treasurer, Lima Gas Light Company, and Lima Natural Gas Company, Lima, Ohio.

Mullen, John J. . . . . March 18, 1903
Traveling Salesman, The Schneider and Trenkamp Company of Cleveland, 726 York Street, Newport, Ky.

Neeley, J. D. S. . . . . March 20, 1901
General Superintendent, Lima Gas Company, Lima, Ohio.

Olds, H. L. . . . . March 21, 1900
Superintendent, The City of Lincoln Gas Company, Lincoln, Ill.

Osborn, H. H. . . . . March 19, 1902
Salesman, American Tank Fixture Company, Chicago, Ill.

Osius, George . . . . March 18, 1890
Secretary and Treasurer, The Michigan Ammonia Works, Detroit, Michigan.

Palmer, Louis T. . . . . March 18, 1903
Secretary and General Manager, Niagara Light, Heat and Power Company, Tonawanda, New York.

Parker, George W. . . . . March 20, 1901
Eastern Agent, Parker-Russell Mining and Manufacturing Company, of St. Louis, 45 Broadway, New York, N. Y.

Pattrell, C. B. . . . . March 20, 1901
Superintendent, Mansfield Gas Light Company, and Mansfield Electric Light and Power Company, Mansfield, Ohio.

Perkins, B. W. . . . . March 21, 1900
Superintendent, The South Bend Fuel and Gas Company, 301 E. Jefferson St., South Bend, Ind.

Perry, A. T. . . . . March 16, 1896
Manager, Barrett Manufacturing Company, 1213 Williamson Building, Cleveland, Ohio.

Persons, Fred R. . . . . March 20, 1889
Representative, The Maryland Meter Company of Baltimore, Maryland, 430 Superior Street, Toledo, Ohio.

Philipp, E. B. . . . . March 16, 1886
Gas Engineer, 78 Ruggery Building, Columbus, Ohio.

Powell, J. H. . . . . March 15, 1893
General Manager, Upper Sandusky Gas Light Company, Upper Sandusky, Ohio.

Powell, William R. . . . . March 18, 1903
Secretary and Treasurer, The Columbus Gas Company, Columbus, O.

Printz, Chas. H. . . . . March 15, 1899
Representative, Fairmount Coal Co., Traction Bldg., Cincinnati, Ohio.

Printz, Eugene . . . . September 17, 1884
Superintendent, The Zanesville Gas Light and Coke Company, N. Sixth St., Zanesville, Ohio.

Price, W. W. . . . . March 21, 1901
General Manager, Dayton Pipe and Cable Coupling Company, 125 Mill St., Dayton, Ohio.

Ritter, Charles S. . . . . March 21, 1900
Chief Clerk, Detroit City Gas Company, Detroit, Mich.

Roper, Geo. D. . . . . March 16, 1892
President, Eclipse Gas Stove Company, Rockford, Ill.

Rothstein, B. F. . . . . March 15, 1899
Salesman, Columbia Incandescent Gas Light Company, 56 East Eighth St., New York, N. Y.

Russell, D. R. . . . . .March 19, 1890
Vice-President, The Parker-Russell Mining and Manufacturing Company, 417 Pine St., St. Louis, Mo.

Sapp, Dwight E. . . . . .March 21, 1900
President, The Coshocton (Ohio) Gas Company, Mt. Vernon, Ohio.

Schall, H. D. . . . . .March 18, 1903
Salesman, Detroit Stove Works, 737 Park Ave., Beloit, Wis.

Schniewind, Dr. F. . . . . .March 19, 1902
General Manager, The United Coke and Gas Company, Whitehall Building, New York, N. Y.

Schwarm, C. A. . . . . .March 20, 1901
Superintendent, Hornell Gas Light Company, P. O. Box 326, Hornellsville, New York.

Seamon, J. F. . . . . .March 16, 1902
General Manager and Secretary, The United Light Company, Uniontown, Pa.

Sears, C. W. . . . . .March 18, 1903
Mt. Vernon Gas Light Company, Mt. Vernon, Ohio.

Shacklette, R. . . . . .March 18, 1903
Cashier, Adrian Gas Company, Adrian, Mich.

Sharp, Wm. G. . . . . .March 21, 1900
President and Manager, The Elyria Gas and Electric Light Company, Elyria, Ohio.

Shattuck, J. D. . . . . .March 19, 1902
Superintendent, Philadelphia Suburban Gas Company, Darby, Pa.

Simpson, J. . . . . .March 20, 1901
General Sales Representative, The Portable Electric Power and Light Company, 188 Railroad Ave., Jersey City, N. J.

Shelton, F. H. . . . . .March 18, 1891
Secretary and Treasurer, Various Gas Companies, 1004 Pennsylvania Building, Fifteenth and Chestnut Sts., Philadelphia, Pa.

Smart, Geo. M. . . . . .March 16, 1887
Secretary, The Dayton Gas Light & Coke Company, S. W. Cor. Main and Second Streets, Dayton, Ohio.

Stacey, A. J. . . . . .March 21, 1900
Sales Agent, The Stacey Manufacturing Company, Cincinnati, Ohio.

Stacey, F. A. . . . . .September 17, 1884
President, Chillicothe Gas Light and Water Co., Chillcothe, Ohio.

Stacey, J. E. . . . . .March 21, 1894
General Manager, The Stacey Manufacturing Co., Cincinnati, Ohio.

Steele, Geo P. . . . . .March 16, 1898
President, Painesville Gas Light and Coal Co., Painesville, Ohio.

Steenbergen, Charles L. . . . . .March 20, 1901
Superintendent, Gallipolis Gas and Coke Co., Gallipolis, Ohio.

Steinwedell, W. E. . . . . March 18, 1903
Secretary, The Gas Machinery Company, 721 Citizens Building, Cleveland, Ohio.

Stevens, J. G. . . . . March 19, 1890
Sales Agent, Welsbach Company, 722 Penn Ave., Pittsburg, Pa.

Stevenson, John B. . . . . March 18, 1896
President and Treasurer, The Van Wert Gas Light Company, Van Wert, Ohio.

Steward, D. M. . . . . March 20, 1901
President, D. M. Steward Mfg. Company, Chattanooga, Tenn.

Steward, Robert Bruce . . . . March, 20, 1901
Vice-President, D. M. Steward Mfg. Company, Chattanooga, Tenn.

Stockstrom, Lewis . . . . March 19, 1890
Secretary and Manager, Quick Meal Stove Company, St. Louis, Mo.

Stone, F. W . . . . March 16, 1898
Manager, Ashtabula Gas Company, Ashtabula, Ohio.

Strain, G. A. . . . . March 19, 1902
Agent, Bellevue Gas Company, Bellevue, Ohio.

Stratton, S. S . . . . March 20, 1899
Agent, The Maryland Meter Company, 88-92 West Jackson Blvd., Chicago, Ill.

Swartz, Howard . . . . March 15, 1899
Secretary and Treasurer, City Heat and Light Co., Fostoria, Ohio.

Tayler, Geo. H. . . . . September 17, 1884
Secretary, Treasurer and Superintendent, Warren Gas Light Company, Warren, Ohio.

Templeton, E. S . . . . March 18, 1896
Secretary and Treasurer, The Ashtabula (Ohio) Gas Company, Greenville, Pa.

Terhune, Chas. F . . . . March 21, 1900
Vice-President, Wm. M. Crane Company, 1133 Broadway, New York, N. Y.

Thompson, John A. . . . . March 20, 1901
Manager and Treasurer, The Lebanon Gas Co., Lebanon, Ohio.

Tittle, Scott M. . . . . March 18, 1903
Inspector, Springfield Gas Company, 461 West Jefferson Street, Springfield, Ohio.

Trenkamp, H. J . . . . March 15, 1899
Secretary, American Stove Company, 479-511 Case Ave., Cleveland, O.

Turney, Henry D. . . . . March 21, 1900
Director and Member Executive Committee, Columbus (Ohio) Gas Light and Heating Company, 80 Broadway, New York, N. Y.

Van Wie, Edwin G. .... March 16, 1892
Manager, Gas Appliance Department, Detroit Stove Works, Detroit, Mich.

Warmington, Daniel R. .... March 16, 1892
Vice-President and General Manager, Peoples Gas Light Company, 810 Pearl Street, Cleveland, Ohio.

Warren, Edric C. .... March 20, 1889
Secretary and General Manager, Century Stove and Manufacturing Company, Johnstown, Pa.

Watt, Robert .... March 21, 1894
Dealer in Coal Tar Products, 911 Association Bldg., Chicago, Ill.

Wells, L. W. .... February 3, 1897
Superintendent, Canton Gas Light and Coke Company, 137 East Fifth Street, Canton, Ohio.

Wendler, B. F. .... March 20, 1901
The Miami Valley Gas and Fuel Company, Dayton, Ohio.

West, William D. .... March 20, 1901
Superintendent, Port Huron Gas Company, 514 Water Street, Port Huron, Mich.

Whysall, George .... March 19, 1890
General Manager, C., D. & M. Ry., Columbus, Ohio.

Wickham, Leigh .... March 16, 1892
Salesman, Parker-Russell Mining and Manufacturing Company, 417 Pine St., St. Louis, Mo.

Witherden, G. M. .... March 15, 1899
With Harris Bros. & Company, Twelfth and Brown Sts., Philadelphia, Pa.

Wones, W. R. .... March 15, 1893
Superintendent Union Light, Heat and Power Co., Covington, Ky.

Woolen, A. L. .... February 3, 1897
Superintendent, Secretary and Treasurer, Fishkill and Matteawau Gas Company, Fishkill-on-Hudson, N. Y.

Wordell, H. H. .... March 18, 1903
Salesman, Welsbach Company, 423 Main Street, Cincinnati, Ohio.

Yawger, Edwin .... March 21, 1900
Westinghouse, Church, Kerr & Company, Westinghouse Building, Pittsburg, Pa.

Young, Peter .... March 21, 1900
Secretary and Treasurer, The Conneaut (Ohio) Gas Light and Fuel Company, Wayne County Bank Building, Detroit, Mich.

York, George W. .... March 20, 1901
Secretary and Treasurer, The Alliance (Ohio) Gas and Electric Company, 309 Garfield Building, Cleveland, Ohio.

ADVERTISEMENTS.

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